NEWLY APPOINTED ASSISTANT CONSERVATORS OF FORESTS.

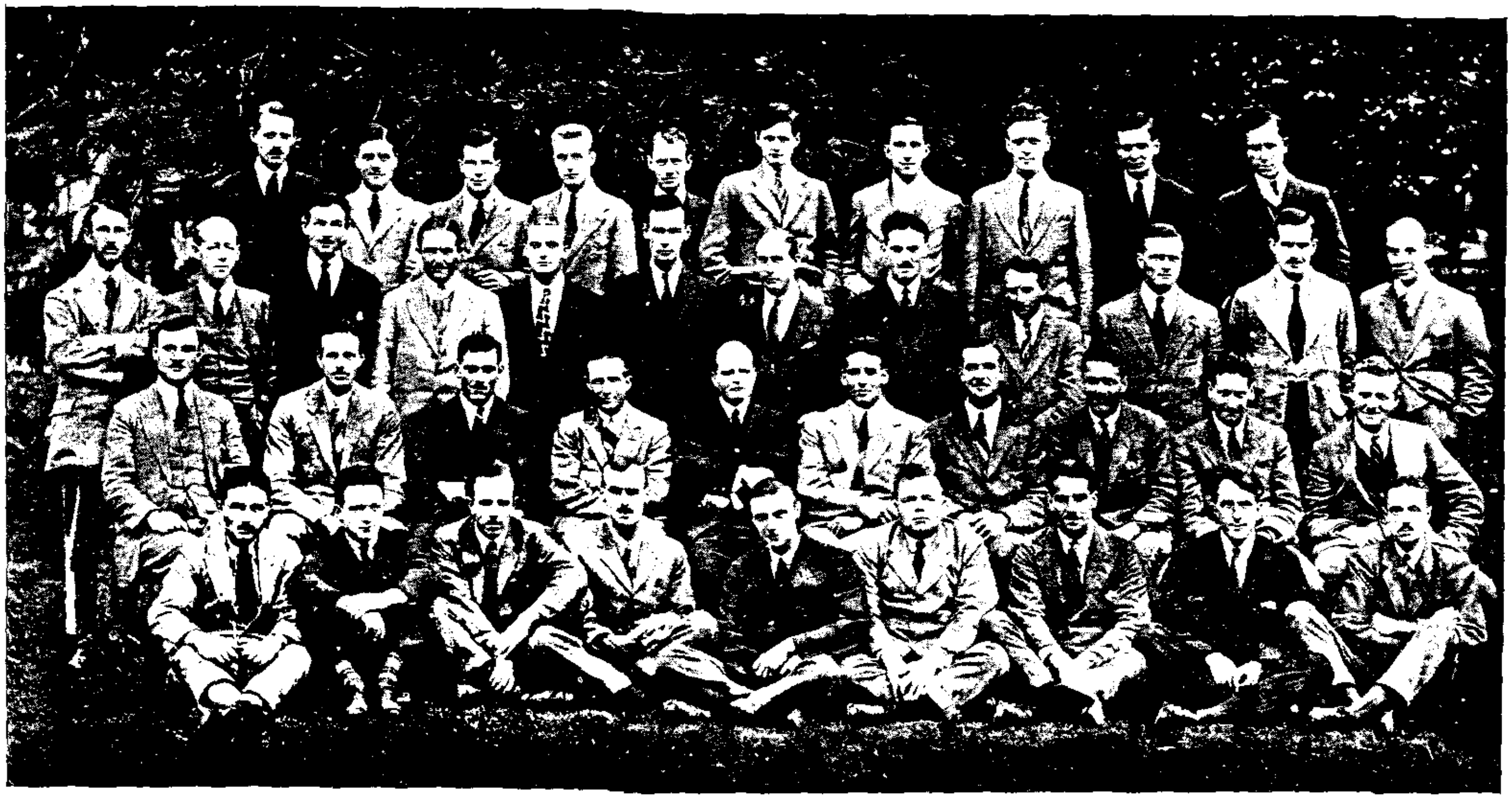

Photo.-Mech. Dept., Thomason College, Roorkee.

Top row (left to right). H. P. W. Davis, C. R. Robbins, F. J. A. Hart, B. H. Osmaston, J. Walker, E. Foster, A. H. Lloyd, W. A. Muir, H. C. Watts, R. A. Macalpine.

Second row from top (left to right). A. S. Thornewill, M. F. Bridge, H. B. Barrett, V. G. Darrington, V. K. Maitland, J. D. Connolly, K. F. R. Dickins, D. Stewart, W. Hodge, D. McD. Currie, D. A. G. Davidson, J. Petty.

On Chairs (seated). (left to right). H. G. Single, D. Davis, H. P. Ward, W. C. de C. Walsh, Mr. A. M. F. Caccia, N. Bor, J. W. Wernham, R. W. V. Palmer, G. R. Henniker-Gotley, F. W. Champion.

Seated on ground (left to right). H. K. McColl, H. M. McKay, J. C. M. Gardner, W. E. Flewett, P. J. Phillips, H. R. Law, F. A. Hart, G. M. Hopkins, A. P. F. Hamilton.

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A DISSERTATION UPON FOREST FINANCE.

It may be of interest to the reader to know the facts which have led me to write the following article :—

Mainly for the purpose of instruction, in Working Plans, to the Senior Provincial Service Classes of this Institute, I have, among other matters, been carrying out researches as to the effect of the cost of money, or the value fixed for "p", on Forest Finance. All my results led me to the same conclusion that the "most profitable rotation," for any species is that of the "highest income." In text-books, the "financial rotation" is spoken of as the "most profitable rotation"; but this simply means that it is the most profitable rotation for a given value of "p". The rotation of the "highest income" is, in fact, the "financial rotation" with "p" at "o". Forest text-books, however, lay down that interest must be allowed on all items of Revenue and Expenditure. That is to say, that the years, in which expenses and receipts occur, must be taken into consideration. This is very true in the case of intermittent returns, or for a single wood. But is it true for the equalised annual working

or for a whole forest? My results led me to the conclusion that it was not true. Now the reason for this is really very simple of explanation. In the case of an unit forest, or series of age gradations, whether the forest is exactly normal or not the annual expenses and receipts will be approximately constant. Provided there is always a surplus, or annual net income, the expenditure during one year will be fully redeemed during the course of the same year. If all the expenditure were incurred at the commencement of the year and the receipts realised only at the end of the year, interest on the expenditure would have to be allowed. But this is not the case. Consider, now, the annual budget of a Local Government in India; the Forest Budget is simply included. No allowance is made for interest on the expenditure *during the year. Similarly, the budget for an unit* forest may simply be included in the Forest Budget. On this basis, the forest, which yields the highest annual surplus, or net income, in proportion to expenditure, is the most profitable. To yield the highest net income, in proportion to the capital invested, a forest must be worked under the rotation of the "highest income," or the "financial rotation," with "p" at "o".

These conclusions involve such a revolution in the theory of "Forest Statics," that I was diffident about putting them on paper. Shortly afterwards, however, I read an article, by Mr. Dureya, in the *Scientific American* for, I think, the 18th June 1921, the object of which was to expose certain fallacies in general finance. The substance of this article was so pertinent to the question I had at issue—the effect of the cost of money upon industries—that I was encouraged to develop my conclusions for publication. I would suggest that Mr. Dureya's article, or extracts therefrom, would be of interest to readers of the *Indian Forester*.

* * * * *

In recent years, calculations of the financial rotations of different Indian species have given results which indicate the advisability of adopting extremely short rotations, on financial grounds. The object of this article is to disprove these conclusions,

That all and sundry may be absolutely convinced of such a revolutionary theory, it is desirable that the proof should be based upon some standard work, such as Schlich, Volume III. The page reference actually refers to the third edition of this work, published in 1905. Since an error may be introduced in Schlich's formula for the cost value of the growing stock of a normal series of age gradations, a formula which is relevant to the question in issue, it is first necessary to prove the possibility of error and to indicate how it should be eliminated.

2. The cost value of the growing stock of a wood, now "m" years old (p. 137), is equal to the value, in the year "m", of all costs of production, less the value of all returns, which the wood has *yielded, before the year "m". Interest on the cost* value of the soil has to be included in the account.

METHOD OF CALCULATION.

Costs of production—

(1) The value, in the year "m" of the cost value of the soil, amounts to $S_c \times 1{\cdot}0p^m$. The interest alone on the cost value of the soil amounts to $S_c \times 1{\cdot}0p^m - S_c = S_c(1{\cdot}0p^m - 1)$.

(2) The value, in the year "m" of the surplus of annually recurring expenses over annually recurring receipts amounts to :—

$$e + e \times 1{\cdot}0p^1 \times \ldots + e \times 1{\cdot}0p^{m-1},$$

the sum of which equals $\dfrac{e\left(1{\cdot}0p^m - 1\right)}{{\cdot}0p} = E\left(1{\cdot}0p^m - 1\right)$.

(3) The value, in the year "m" of the cost of formation, amounts to $c \times 1{\cdot}0p^m$.

Receipts—

These consist of all previous thinnings and items of other incomes, realised before the year "m"; they may be represented by $T_a, T_b \ldots T_l$. Their value, in the year "m", amounts to :—

$$T_a \times 1{\cdot}0p^{m-a} + T_b \times 1{\cdot}0p^{m-b} + \ldots + T_l \times 1{\cdot}0p^{m-l}.$$

General Formula.

$$= S_c\,(1{\cdot}0p^{m} - 1) + E\,(1{\cdot}0p^{m} - 1) + c \times 1{\cdot}0p^{m} - (T_a \times 1{\cdot}0p^{m-a} + \ldots\ldots + T_l \times 1{\cdot}0p^{m-l})$$

$$= (S_c + E)\,(1{\cdot}0p^{m} - 1) + c \times 1{\cdot}0p^{m} - (T_a + 1{\cdot}0p^{m-a} + \ldots\ldots + T_l \times 1{\cdot}0p^{m-l}).$$

3. The cost value of the growing stock of a normal series of age gradations (pp 143 and 157) is obtained by summing the cost values of all the age gradations from "0" to "r—1" years.

Method of Calculation.

$${}^{0}G_c = (S_c + E)\,(1{\cdot}0p^{0} - 1) + c \times 1{\cdot}0p^{0} +$$

$${}^{1}G_c = (S_c + E)\,(1{\cdot}0p^{1} - 1) + c \times 1{\cdot}0p^{1} + \ldots\ldots +$$

$${}^{a}G_c = (S_c + E)\,(1{\cdot}0p^{a} - 1) + c \times 1{\cdot}0p^{a} - T_a +$$

$${}^{a+1}G_c = (S_c + E)\,(1{\cdot}0p^{a+1} - 1) + c \times 1{\cdot}0p^{a+1} - T_a \times 1{\cdot}0p^{1} + \ldots\ldots +$$

$${}^{r-1}G_c = (S_c + E)\,(1{\cdot}0p^{r-1} - 1) + c \times 1{\cdot}0p^{r-1} - (T_a \times 1{\cdot}0p^{r-a-1} + \ldots\ldots + T_q \times 1{\cdot}0p^{r-q-1}).$$

By summation of the above, the cost value of the growing stock of a normal series of age gradations amounts to :—

Normal—

$$G_c = (S_c + E)\,(1{\cdot}0p^{0} + \ldots\ldots + 1{\cdot}0p^{r-1}) - r\,(S_c + E) + c\,(1{\cdot}0p^{0} + \ldots\ldots + 1{\cdot}0p^{r-1})$$

$$-\,[T_a\,(1 + 1{\cdot}0p^{1} + \ldots\ldots + 1{\cdot}0p^{r-a-1}) + \ldots\ldots + T_q\,(1 + 1{\cdot}0p^{1} + \ldots\ldots + 1{\cdot}0p^{r-q-1})]$$

$$= \frac{(S_c + E)\,(1{\cdot}0p^{r-1})}{{\cdot}0p} - r\,(S_c + E) + \frac{c\,(1{\cdot}0p^{r} - 1)}{{\cdot}0p} - \left[T_a\,\frac{(1{\cdot}0p^{r-a} - 1)}{{\cdot}0p} + \ldots + \frac{T_q\,(1{\cdot}0p^{r-q})}{{\cdot}0p}\right].$$

$$= \frac{(S_c + E + c)\,(1{\cdot}0p^{r} - 1) - [T_a\,(1{\cdot}0p^{r-a} - 1) + \ldots + T_q\,(1{\cdot}0p^{r-q} - 1)]}{{\cdot}0p} - r(S_c + E).$$

This is the formula, in Schlich, for the cost value of the growing stock of a normal series of age gradations.

4. Now, in the last formula, the term $\frac{S_c(1{\cdot}op^r - 1)}{{\cdot}op} - r \times S_c$ represents the sum of the interest on the cost values of the soil of "r" age gradations, in the year "r— 1." That this is not always the *case can be proved.* "S_c" *represents the cost value of the soil, of* one age gradation, in the year afforestation commenced. Unlike the amounts spent on formation, etc., which are only incurred in the year of formation of each age gradation, the *cost of the* soil is incurred for all age gradations in the year "o". Interest, may, therefore, have to be allowed, on the cost value of the soil from the year afforestation commences to the *year of formation* of each age gradation. In other words, "S_c" is not necessarily a constant, but may vary for each age gradation. Take the case in which one age gradation is planted up *annually and the remaining* areas are allowed to lie fallow until they are required for afforestation. The values of "S_c", in the years of formation of the o, 1, ... m, ... r – 1 age *gradations, will* be $S_c \times 1{\cdot}op$, $S_c \times 1{\cdot}op^{r-1}$, ... $S_c \times 1{\cdot}op^{r-m}$, ... $S_c \times 1{\cdot}op^1$. Then the value, in the year "r – 1", of the interest on the cost values of the soil of "r" age gradations, "o" *to* "r – 1" *years old*, will amount to :— $(S_c \times 1{\cdot}op^r)\ 1{\cdot}op^o - S_c + (S_c \times 1{\cdot}op^{r-1})\ 1{\cdot}op^1 - S + \ldots\ldots + (S_c \times 1{\cdot}op^{r-m})\ 1{\cdot}op^m - S_c + \ldots\ldots + (S_c \times 1{\cdot}op^1)\ 1{\cdot}op^{r-1} - S_c$. Each of these *terms reduces to* $S_c \times 1{\cdot}op^r - S_c$. Their *sum,* therefore, amounts to $S_c \times r \times 1{\cdot}op^r - r \times S_c$. That this is correct is obvious, if the question is viewed from another stand-point. In the year "o," *the cost value* of the "r" units of land equalled $S_c \times r$. One unit was afforested annually and a normal series of age gradations, "o" to "r – 1" years old, was established in "r" years. The total interest on the cost of acquisition, etc., for the intervening period, would have amounted to $S_c \times r \times 1{\cdot}op^r - r \times S_c$, as before. It can be shown that the term $\frac{S_c(1{\cdot}op^r - 1)}{{\cdot}op} - r \times S_c$ is only one-half of the term $S_c \times r \times 1{\cdot}op^r - r + S_c$. In this

case, therefore, the formula for the cost value of the growing stock of a normal series of age gradations would be as follows :—

$$\text{Normal } G_c = S_c \times r \times 1{\cdot}0p^r + \frac{(E+c)(1{\cdot}0p^r - 1) - [T_a(1{\cdot}0p^{r-a} - 1) + \ldots + T_q(1{\cdot}0p^{r-q} - 1)]}{{\cdot}0p} - r(S_c + E).$$

5. Indeed, it can be shown that the formula, for the cost value of the growing stock of a normal series of age gradations, should vary according to the use to which the land is put, so long as it is not required for the formation of a normal series of age gradations. On acquisition of land, with a view to the establishment of a normal forest of any species, the prudent forest officer will make the best use of each area, until it is required for afforestation with the selected species. Such areas may be used for agriculture, pasture, etc., or even temporarily for forestry. If such provisional undertakings cannot be made to pay, it would be better to let the land lie fallow, until required for cultivation with the selected species. If, on the other hand, net returns are obtained, they should be set against the interest charges on the cost of acquisition. Not only may it be possible to pay up the interest charges, but also to redeem a part, or the whole of the capital cost. In fact, separate culculations should be made to determine the cost value of the soil of each age gradation, in the year of its formation. Such values of "S_c" should be introduced into the account, in calculating the cost value of the growing stock of a normal series of age gradations. The general formula for such cost value should, therefore, be modified to suit each particular case.

6. This possibility of error, in the practical application of Schlich's formula, is of considerable importance, since the cost values of the soil and growing stock should be utilised for the determination of the financial results in Forestry. These can be determined (p. 151, etc.,), either by ascertaining the "profit", or the "mean annual forest per cent." These, again, can be calculated, either for single woods, or for a normal series of age gradations :—

(1) For single woods, the profit, or $P = S_e - S_c$;

(2) " " the mean annual forest per cent $= \frac{S_e}{S_c} \times p$;

(3) For a normal series of age gradations, $P = F_e - F_c$;

(4) „ „ „ the mean annual forest per cent. $= \frac{F_e}{F_c} \times p$.

7. Now, the determination of the financial results in Forestry, by ascertaining the profit, or mean annual forest per cent. of a single wood, is not sound. This is due to the fact, as has been stated above, that land, acquired for Forestry, is not generally afforested in one year, but over a series of years. The cost values of the soil of the areas afforested in the years "o" and "r—1" might be, respectively, "S_c" and "$S_c \times 1{\cdot}0p^r$." The profit derived from the former wood would be greater than that from the latter, by an amount equal to the interest on "S_c", during "r" years, or by $S_c \times 1{\cdot}0p^r - S_c$. The mean annual forest per cent. varies, also, for the same reason. The true financial results of Forestry, however, can be determined by ascertaining the profit, or mean annual forest per cent. of a normal series of age gradations, provided the correct values of "S_c", in the years of formation of each age gradation, are introduced into the account.

8. Since the expectation and cost values of a normal series of age gradations depend upon the corresponding expectation and cost values of the soil and the growing stock, the elimination of all error in the formula for the cost value of the growing stock of a normal series of age gradations becomes of very real importance. In the example on p. 157, it would appear that acquisition of "r" acres of soil, at 300 shillings per acre, and continuous cultivation with Scots Pine, would be financially sound. The capital invested, besides yielding 2½ per cent, interest, is shown to give a profit of 26,024 shillings. If the formula, given in paragraph 4, had been applicable, the cost value of the forest would have exceeded the expectation value by 72,495 shillings. In which case, the capital invested would have yielded only 1·58 per cent. interest, thereby involving a financial loss.

9. From the above facts, the following conclusions may be drawn :—cf. p. 153). Provided the correct value of "S_c", in the

years of formation of each age gradation, are introduced into the account :—

(1) The true financial possibilities of Forestry should be determined by ascertaining the Profit, or Mean annual forest per cent. of a normal series of age gradations.

(2) A profit could be realised, if the sum of the cost values of the soil and growing stock of a normal series of age gradations is less than the sum of the corresponding expectation values.

(3) A profit could, also, be realised, if, although $F_e = F_c$, on establishment of a normal series of age gradations, the expectation value of the forest is afterwards increased, either by higher returns, or by smaller costs, or both ; in other words, by improved and more economic management.

(4) If the cost value of a normal series of age gradations is equal to the expectation value, the profit is *nil*, and the capital invested would yield exactly "p" per cent. If the cost is greater than the expectation value, the enterprise will involve a financial loss ; in that case, it is more profitable to take the capital out of the forest and invest it otherwise, as long as in this way "p" per cent. can be obtained with equal security.

10. The security furnished by any investment is the true indication of its financial soundness. The greater the security, the lower is the rate per cent. with which an investor is content. The investor is certain of full redemption of his money. He is taking little or no risk and has, therefore, no need to gamble against possible loss. There is, however, no reason why a good security should not yield a high rate per cent. or a large profit. Indeed, it will do so, if money can be obtained for its acquisition and development, on favourable terms. This can be very well illustrated in the case of forest property.

11. Examples may, for convenience, be based upon the data at p. 120. Assume that a man is able to obtain all the money he

requires, for the acquisition and development of a forest property at $2\frac{1}{2}$ per cent. His object should be the attainment of the maximum profit, *compatible with certain redemption of the loan or* loans he has to negotiate. To this end, the forest officer should determine the species most suited to the locality and the most profitable rotation. *This latter* will be the rotation, for which "S_e", or the expectation value of the soil culminates, with "p" at $2\frac{1}{2}$ per cent. For this rotation, he should proceed to calculate the expectation and cost values of the forest. The difference between "F_e," and "F_c," *will indicate, not only the amount of profit which* he can obtain, but also whether the investment is financially sound. Taking the examples at pp. 156 and 157, and assuming that the land is to lie fallow *until afforested* with the selected species, the value of $F_c = 123{,}860$ shillings and the value of "F_c," the formula for "G_c," given in paragraph 4, being applicable, equals 196,355 shillings. *Since* $F_c > F_c$, there would not only be no profit in the undertaking, but he would be able to pay *only* 1·58 per cent. *on* all the borrowed money. In fact, the security offered for such loans would be insufficient to ensure redemption. *If, now, the necessary money* could have been borrowed at 2 per cent., the financial rotation would have been 90 years and "S_c" would have been equal to 713 shillings. The value of "F_e" would *have been 195,450 shillings* and the value of "F_e" *179,690 shillings.* Since $F_e > F_c$, all borrowed money could have been redeemed at 2 per cent. and a profit of 15,760 shillings obtained. This profit, as received, could have been invested in any concern or *utilised for the declaration of dividends.* *Similarly,* it could be shown that, if the necessary money could have been obtained at a lower rate of interest, the security would have been sufficient to redeem it and would have yielded a still greater profit to the forest officer. The cost of money, *therefore*, not only affects the profit in forestry, but also the degree of security furnished by any such *undertaking*.

12. It can also be shown that the cost of acquisition of land for forest purposes, or the cost value of the soil, has a similar effect. Assume, in the above examples, that the value of $S_c = 100$,

nstead of 300 shillings. If money is borrowed at $2\frac{1}{2}$ per cent. there will be a profit of 42,858 shillings, after redeeming the loan. Cheaper acquisition of the land, in this case, converts an unprofitable undertaking into a profitable one. If money is borrowed at 2 per cent. there will be a profit of 122,736 shillings. In this case, an increased profit would have been obtained. It is also interesting to note the percentage, in this latter example, yielded by the invested capital. The mean annual forest per cent. or $\frac{F_e}{F} \times p = 5{\cdot}4$. Of this 2 per cent. goes to redeem the borrowed money and 3·4 per cent. is available for the declaration of dividends.

13. Quite apart from the possible error, which may be introduced in the practical application of the general formula for the cost value of the growing stock of a normal series of age gradations, the following conclusions may be drawn from the above facts:—

(1) The cost of money, or the value of "p" adopted in financial calculations has a very great effect upon forest finance, in that it affects the expectation and cost values of a forest in opposite ways.

(2) The cost of acquisition of forest lands has also a very great effect upon forest finance, in that it is a large item in the cost value of a forest.

(3) In addition to the factors which actually endanger the existence of the whole, or a part of the forest, the security furnished by a forest is largely affected by the cheapness of money and the cost of acquisition of the land.

(4) The lower the cost of money and the cost of acquisition of the land, the greater is the security furnished by a forest and the greater is the profit which it can yield.

14. When these principles are applied to Government forests, particularly such forests in India, it can be shown that the financial prospects of such forestry are very favourable. In the first place, Governments are institutions which can afford to

lend money for long periods, at a low rate of interest, even though they may temporarily have to borrow money at a much higher rate. They must, however, be satisfied that the concern, which they agree to finance, furnishes sufficient security to safeguard them against loss. For instance, if the Government of India, to-day, were to lend money to the Forest Department at 2 per cent. which they had borrowed at 6½ per cent., with the object of developing a particular concern, they would be justified in doing so, provided that they were satisfied that such concern would yield 6½ per cent. Indeed, it is not necessary to go to such an extreme, provided the concern would eventually yield the average rate per cent. at which Government could expect to borrow money in the intervening period, such a loan would be financially sound. If this argument is carried to its logical conclusion, Governments can afford to lend money to their producing Departments, free of interest, against an adequate security. In other words, they can afford to issue paper money to the public against the security furnished by their producing Departments. In the second place, the majority of Government forests in India have been acquired at a very low cost. By the time such forests are brought under intensive management, however, the low initial cost may have increased to a considerable extent, on account of interest charges. On the other hand, the initial cost included not only the soil, but the growing stock in addition. The sale of such growing stock may be set against the above interest charges. With cheap money and low cost of acquisition it may reasonably be expected that intensive forestry, in India, will yield high profits, furnishing ample security for the redemption of Government loans.

15. Such profits, however, will be seriously curtailed, if the usual procedure of calculating the financial rotation is continued. The present procedure involves the pre-determination of the cost of money, or a value for "p". With such value, the financial rotation is calculated and attempts are made to work approximately to such rotation. It is now claimed, that such pre-determination of the value of "p" is financially unsound. Since

Government can afford to lend money, even free of interest, against an adequate security and, thereby increase the profits of forestry, why pre-determine a value for "p" at all? In fact, if Government advances money for the development of a Government forest, the most profitable rotation is the "rotation of the highest income." Now, in the case cf any forest, the annual income will continue to rise, until the volume and quality increment become so much reduced that they will cause a reduction in the average income (p. 202). The rotation of the highest income is likely, therefore, to be unduly long.

16. The procedure now advocated in the case of Government forests is to determine the rotation according to the objects of management. In one case, the rotation may be fixed mainly on silvicultural grounds. In another, the rotation may be chosen for the production of a particular class of produce. In general, the rotation most suitable for silvicultural reasons and for the production of those classes of produce most in demand, should be selected. For such rotation, the security furnished should be ascertained. This can be done in a variety of ways. It can be most accurately assessed by the determination of the mean annual forest per cent. for a normal series of age gradations. An allowance should then be made for probable abnormalities in the real forest, as established. If this reduced percentage is sufficiently high to ensure Government against loss, the undertaking may be considered financially sound. For the purposes of this test, a value for "p" should be fixed at least equal to the anticipated average Government borrowing rate, for the ensuing fifty to one hundred years. If the reduced mean annual forest per cent. is equal to, or greater than "p", the Government will not only be ensured against loss, but will obtain the highest profits, commensurate with silvicultural and other general considerations. The procedure advocated is, thus, extremely elastic, gives the forest officer a free hand for the attainment of the objects of management and is financially sound. Moreover, the longer the rotation necessary for the attainment of the objects of management, generally the more profitable will be the financial results of forestry.

17. To demonstrate this procedure, a practical example may be given. With the same data as before, assume a proposal to establish a Scots Pine forest, with a view to a sustained annual yield, the land to lie fallow until actually required for afforestation. Assume that, for silvicultural and general reasons, a rotation of 90 years is considered best and has been selected. The value of "p" for which the expectation value of the soil culminates at 90 years, or the current forest per cent. of an average wood, 90 years old, will be 2 per cent. It is desired that the Government should advance the necessary money for the acquisition of the land and the establishment of a normal series of age gradations, at 2 per cent. On the other hand assume that the Government cannot reasonably expect to borrow money, during the next 90 years, at an average rate lower than 4 per cent. To ensure the Government against loss, the forest must pay at least 4 per cent. This example has been quoted in paragraph 12 above, where it is shown that the mean annual forest per cent. would have been 5·4 per cent. Even making allowances for abnormalities in the real forest, as established, the Government would thus be ensured against loss. Moreover, a rotation of 90 years would be far more profitable than one of 60 years, which is the financial rotation with "p" at 4 per cent. In this latter case, the mean annual forest per cent. would have been only 1·8 per cent. Under the ordinary procedure, of pre-determining "p" at 4 per cent. and calculating the corresponding financial rotation, it would have appeared unprofitable even to have commenced the above undertaking.

18. In the absence of yield tables, the determination of the security furnished by a forest project presents certain difficulties. It is believed, however, that these difficulties can be overcome in India. This is mainly due to the fact that the majority of forests have been acquired at a purely nominal cost. For instance, all the forests in the South Malabar Division of the Madras Presidency have been leased, or purchased in the open market. The earliest lease was executed in 1840 and the latest purchase completed in 1886. The average cost value per acre, in 1920, allowing 3½ per cent. Compound interest on all items, is Rs. 12½. In this

case, no revenue by sale of the old growing stock has been set against the interest charges. Since these are the facts in respect of leased and purchased forests, it may confidently be anticipated that the cost value of the majority of Indian forests is less. If revenue derived from the old growing stock is set against these charges, the cost value of the soil may even be ignored. If, in the examples quoted in paragraph 12 above, the cost value of the soil had been nil, profits with money borrowed at 2½ and 2 per cents., would have been, respectively, 100,535 and 176,224 shillings. In the latter case, the mean annual forest per cent. would have been 20·3, instead of 5·4 per cent. If a forest of Scots Pine of average quality can, in such circumstances, yield such a high rate per cent., it may reasonably be expected that the majority of Indian species, which are generally of a greater net value and faster grown, will yield a still higher rate per cent. If this is so (and the Nilambur Teak plantations yield an astounding rate per cent.), very approximate methods should suffice to prove, to Government, the financial soundness of investment of large sums of money in intensive forestry in India.

19. In conclusion, it is hoped that the theory outlined above has been made sufficiently clear. The detailed working, in connection with examples quoted, has been purposely omitted. To satisfy themselves, readers will be compelled to work out examples on their own. In this way, any mistake should be brought to light. A theory, of such practical influence, is never proved until it has been universally accepted. Will readers help to prove it? If proved, the procedure advocated will be an advance, even comparable with the advance represented by Judeich's "Bestand Wirtschaft" on the formula methods of regulating the yield. Finally, it is desired to thank Mr. Howard, Silviculturist, for his criticisms and suggestions on the original manuscript, which have enabled the writer to indicate, more clearly, the possible errors to be eliminated, in the practical application of Schlich's general formula for the cost value of the growing stock of a normal series of age gradations.

R. BOURNE, I.F.S.,
Instructor, F. R. I. and C

THE CONVERSION OF COPPICE AND COPPICE-WITH-STANDARDS TO HIGH FOREST.

There has been for many years a growing dislike among French forest officers of the systems of coppice and coppice-with-standards. This dislike is partly due to the decline in the value of the products from such systems and partly to the realisation of the fact that the soil is far better utilised under high forest than under artificial systems of coppice. This dislike culminated during the late war, when it was found that coppice systems provided practically no reserve which could be called upon in the time of national emergency.

Hence the conversion of good quality coppice to broad-leaf high forest, and of poor quality coppice to coniferous high forest, now finds many advocates, and is being largely carried into practice.

The following are the arguments for and against such conversion:—

Arguments in favour of Conversion are—

(1) High forest implies more intensive culture than coppice-with-standards, since it makes the fullest use of the soil and accumulates a large capital.

(2) High forest supports a denser population and furnishes a greater variety of products, whose value is proportionately much greater in comparison with the cost of the labour employed.

(3) It is the policy of the State to produce the large-size timber and variety of products such as only high forest can provide.

(4) High forest provides a valuable reserve which may be called upon in the time of great financial or national emergency such as the late war.

(5) The value of the products from the coppice systems has greatly declined.

(6) In France the expenses due to taxation and policing are proportionately less for high forest than for coppice systems.

Arguments against Conversion are—

(1) *Financial*—based on the low rate of interest given by high forest. Even for privately owned woods, these considerations

have now lost their weight under post-war financial conditions.

(2) *Economic*—founded on the sacrifices necessarily involved in conversion. This view was certainly correct at one time when the prolonging of the rotation resulted in a waiting period during which the income ceased altogether. M. Aubert's system, however, does away with this period of waiting and converts the coppice to high forest in one conversion felling by retaining a far larger number of standards. The retention of these standards will mean a diminution—but not a cessation—of revenue, and even this diminution merely corresponds to an increase in capital which will subsequently produce a far greater income. The forester, by reserving a baliveau in full increment, does no more than an economist who puts a little of his income in the savings bank.

(3) *Technical*—these are considered to be the most serious, but are largely due to the attempts to bring about the conversion through the establishment by natural reproduction of seedling stands with a regular distribution of age classes. The State forests of Bourse and of Ecouves prove that, at least in the oak and beech forests of western France, the establishment of satisfactory high forests from thrifty trees is not only comparatively easy from a cultural point of view, but can be effected at a considerable saving of time and money.

A perusal of the foregoing arguments show that the conversion of coppice systems to high forest is fully justified. As to the actual method of effecting the conversion, a comparison between the old method and that advocated by M. Aubert will show the advantages possessed by the latter.

Normal Method of Conversion.

Periods	P. B. I.	II.	III.	IV.
0—30 years...	Select P. B. I. and allow preparatory period of rest during which the coppice grows up.	Normal Coppice with Standards fellings. These blocks are not yet selected.		

Periods	P. B. I.	II.	III.	IV.
31–60 years	Regeneration fellings.	Select P. B. II and allow preparatory period of rest during which the coppice grows up.	Normal C. W. S. fellings. These blocks are not yet selected.	
61–90 years	Tending operations and artificial regeneration if necessary.	Regeneration fellings.	Select P. B. III and allow preparatory period of rest during which the coppice grows up.	Normal C. W. S. fellings. This block consists of the remainder of the area for conversion.
91–120 years	Tending operations.	Tending operations and artificial regeneration if necessary.	Regeneration fellings.	Preparatory period of rest during which the coppice grows up.
121–150 years.	Tending operations.	Tending operations.	Tending operations and artificial regeneration if necessary.	Regeneration fellings.

Under this method the conversion rotation has increased from the normal rotation of 120 years to 150 years. Income from each periodic Block in turn ceases during the period of rest during which the coppice grows up.

Aubert's System of Conversion.

Suppose that a series is ready for conversion; then it will contain a normal gradation of coppice-with-standard coupes, aged from 1 to 30 years old. Then under Aubert's method each annual coupe, as its turn comes for the ordinary coppice felling, is treated under a "*Balivage intensif*" as follows. This "*Balivage intensif*" means that instead of clear felling the coppice, a certain number of the best seedlings and coppice shoots are marked to be retained as standards to constitute the future high forest. Seedlings are chosen as far as possible but coppice shoots answer the purpose perfectly well, and the number retained varies

between 300 and 500 per hectare including the '*modernes*' and '*anciens*.' The object of this operation is to reserve a sufficient number of '*Baliveaux*' and '*Modernes*' on the area to form a closed canopy within the next 10 years. In addition most of the large standards (*anciens*) are cut out so as—

(1) to even up the crop as far as possible;

(2) to compensate for the loss of income involved in the reservation of the 300 to 500 baliveaux.

The table of operations is as follows :—

0—30 years ...	Conversion fellings over the block under conversion, one parcelle per annum, retaining 300 to 500 baliveaux per hectare, and removing most of the *anciens* and many of the *modernes*.
31—60 years ...	Thinning under a 7 to 10 year thinning cycle. Removal of any remaining suppressed or suppressing *anciens* and *modernes* with the object of improving and evening up the crop.
60 years upwards ...	Thinnings continued. Regeneration operations may be commenced whenever required, but the crop is generally comparable to a seedling high forest.

The result of this "Balivage intensif" is to leave an open irregular crop, which does not look as though it would even up or produce a complete canopy for a very long time. Actually however the new high forest closes up in a most extraordinary manner, and after a few decades of thinnings it is almost impossible to tell it from a high forest constituted in any other manner, except by the presence of grown-up coppice shoots. A few years after the couversion operation, the thinnings commence to produce returns which largely compensate for the loss of the ordinary coppice yields.

Results of the Method when put into Practice in the Forêt d'Ecouves.

Area—7,500 hect.

Altitude—200 to 415 metres, the latter the highest point in W. France.

Aspect—Abrupt slopes with every aspect.

Soil—Subsoil is in parts impermeable clay and elsewhere sandstone or pure sand. The soil includes every type of flinty soil. In the hollows and on the borders are alluvial formations of

better quality. The situation of this forest is at the meeting point of four types of climate, which thus renders the results obtained here applicable to an extensive region.

History—The forest has had many vicissitudes first coming under systematic management in 1667. New working plans were made in 1867 and 1880. The Working Plan officer of 1867 had to deal with a very varied stocking and decided to convert the whole forest to high forest; the worst parts to be replaced by Scots Pine, the best parts to be regenerated naturally, and the better coppice to be grown into high forest.

This Working Plan proved to be too drastic, and was revised in 1880, when 4,500 hectares were put back to coppice-with-standards with the following prescriptions :—

(1) Where the growth is good, high forest is to be built up by marking a large number of coppice shoots as reserves, *i.e.*, Aubert's system.

(2) Inferior portions to be clear-felled and stocked with Scots Pine.

Results—These prescriptions have been carefully followed for the last 40 years except that silver-fir is now substituted for Scots Pine. The result is that regeneration has been obtained everywhere without difficulty, whatever may have been the age chosen for regeneration. This proves that in the W. of France regeneration by seed from grown-up coppice is generally easy.

The converted coppice falls into three categories :—

(*a*) *Good soil with few standards which were mostly baliveaux and modernes.*—The crop has developed without difficulty: the converted coppice has quickly joined up with the standards: the standards have adapted themselves to the new type of forest and have put on height growth. In such woods transition to high forest has proved easy and successful. Examples are parcelles E 4 to H 4 and A 5 to F 5 of the 1st series now 70 to 90 years old.

(*b*) *Good soil, but a large number of anciens retained.*—Results are not so good as in (*a*) owing to the unaccommodating nature of the *anciens*,

(c) *Poor soil.*—Results very poor, consisting of short and twisted poles neither suitable for regeneration nor for reversion to coppice. Fortunately the situation has been saved in this case by the introduction of silver-fir.

These results establish the following points :—

(1) That it is possible to pass direct from coppice to high forest in a single operation. Most of this high forest will however be of stool-shoot origin.

(2) Poor coppice which cannot be converted under the ordinary method, also cannot be converted under Aubert's method.

(3) It is better to remove practically all the *anciens* and most of the *modernes* as these are generally too old to accommodate themselves to the new conditions of the crop.

(4) The operation under Aubert's system is economical in both time and money. Of time by doing away with the long preparatory period entailed by the ordinary method, and of money, because the conversion felling furnishes at once a revenue of importance whereas thinnings in the converted crop start shortly afterwards.

(5) Grown-up coppice shoots can produce good quality high forest capable of producing copious natural regeneration.

(6) The presence of a certain proportion of beech in the coppice facilitates the operation.

(7) The number of *Baliveaux* reserved (300 to 500) has proved to be somewhat too few, in that the resultant forest tends to be a little too open.

Application of the Method to Good Quality Private Coppice.

The conversion should be attempted only if the young trees of the future stand out in the crop : if the possibility of developing then is assured : and if the subjects of the *balivage* are sufficiently vigorous to resist wind and snow damage. This means that the coppice must be between 20 and 30 years old. The number of *baliveaux* has proved to be somewhat too few at Ecouves, so that in private coppice, whose rotation is probably 20 or 25 years, the reserves may number up to 1,000 per hectare. If such a large number of good quality *baliveaux* is not available the

number may be completed by retaining inferior species temporarily with the idea of removing them later in thinnings. If such a large number of standards be retained, however, there will be a considerable reduction in the returns from the coppice felling.

Plan of Operations.

M. Aubert states that it is unnecessary to lay down in advance a complete series of age gradations for the future high forest, since in State forests parcelles are frequently transferred from one periodic block to another, thus advancing or retarding regeneration by a large number of years. It is best to start by *enriching the forest as rapidly* as possible with the idea of arranging later for the periodic blocks and regeneration according to the results obtained.

Conclusions and Advantages of M. Aubert's Method.

(1) The method is perfectly practicable and is actually being used with excellent results.

(2) It is applicable only to coppice which can be converted under the normal method.

(3) It differs from the normal method in that it aims at the direct conversion of coppice to high forest and not at obtaining in the distant future a high forest of natural seedlings.

(4) As compared with the normal method it is economical in both time and money. Of time by doing away with the long preparatory period, and of money because the conversion felling produces at once a revenue of importance, whereas thinnings in the converted crop start soon after.

(5) It is applicable to private coppice with an increased number of reserves.

(6) Under Aubert's system the trees of the resultant forest tend more towards diameter than to height growth owing to the open nature of the crop.

(7) The method is particularly applicable to the numerous areas of good quality coppice in which all the standards have been sacrificed to the needs of the war.

F. W. CHAMPION.

MORTALITY OF SAL IN BUXA DIVISION, BENGAL.

(1) GENERAL.

In 1913 it was observed that the outturn of dry sal was very large. The figures are given below :—

Year.		Logs c.ft.	Poles c ft.	Total c.ft.
1905-06	...	53,517	2,57,973	3,11,490
1906-07	...	98,048	3,87,960	4,86,008
1907-08	...	1,37,108	4,75,395	6,12,503
1908-09	...	1,44,546	5,78,812	7,23,358
1909-10	...	1,60,063	4,63,625	6,23,688
1910-11	...	2,55,905	4,25,770	6,81,675
1911-12	...	4,25,381	4,53,046	8,78,427
1912-13	...	3,93,584	2,74,052	6,67,636
			Total ...	49,84,785

Average outturn for 8 years—6,23,098 c.ft.

An enquiry was instituted to ascertain the causes of this abundance of dead sal timber. The results of the enquiry were :—

(1) That the figures were found to be inaccurate as they included refuse from green trees felled for sleeper operations.

(2) That there had been wholesale deaths due to rivers changing their courses on the Rydak and Dima in 1911.

(3) That there was serious mortality from—

(*i*) Climbers.

(*ii*) Wind fall.

(*iii*) Insect attack.

The system for exploiting dry sal at this period was for the purchaser to go into the forest, fell and dress any dry tree he liked, and bring the timber to a depôt for measurement and assessment of royalty. It was suggested at the time by the Inspector-General of Forests that the manufacture of dry trees was going

on to a considerable extent, but this view was not favoured by the Divisional Forest Officer or the Conservator of Forests who ascribed the mortality to creepers, insects and unknown causes.

Accordingly—

(1) the exploitation of dry sal was regulated on a 6 year rotation and trees were marked before felling and sold in lots by auction ;

(2) a revised scheme for creeper cutting was introduced and

(3) the Forest Zoologist was called in to investigate the deaths caused by insects.

The regulating of dry sal working resulted in a considerable reduction in the outturn of dry sal timber as will be seen from the figures below :—

Year.			Logs c.ft.	Poles c ft.	Total c.ft.
1913-14	...	...	1,43,180	6,684	1,49,864
1914-15	...	...	84,661	19,866	1,04,527
1915-16	...	...	91,739	11,696	1,03,435
1916-17	...	...	1,08,734	5,581	1,15,315
1917-18	...	...	1,14,314	44,040	1,58,354
1918-19	...	...	1,34,605	18,968	1,53,573
1919-20	...	...	1,10,799	19,503	1,30,302
				Total ...	9,15,370

Average outturn for 7 years—1,30,767 c.ft.

The outturn of dry sal thus fell immediately to about one-fourth of its previous average amount and has not varied very greatly since. Hence allowing that only half the dry wood is extracted it may be assumed that the normal production of dry sal is not more that about 3,00,000 c.ft. per annum. This rather looks as if the Inspector-General of Forests was right when he suspected the "manufacture" of dry sal, since—

(1) the erosion mortality occurred in the rains of 1911 and could not have affected previous years ;

(2) the increased creeper cutting cannot be supposed to have produced such an enormous change immediately, as a round of creeper cutting had been completed in 1910-11 ; and

(3) there had been considerable working of dry sal before the introduction of the Working Plan in 1906, so very large accumulations of dead wood cannot have existed.

The waste from departmental operations also cannot have been responsible for more than about 1,00,000 c.ft. per year at the outside.

The above figures demonstrate (if demonstration is necessary) the unsoundness of the system of "selection by purchasers."

Now if we take it that the normal production of dry timber is 3,00,000 c.ft. per year, what death-rate does this represent? The figures given in the Working Plan of 1906 for the sal trees in the whole plains forest were:—

	No. of trees in July 1905.
Class I, over 2′ diameter	46,995
„ II, 1½′ to 2′ do.	2,85,261
„ III, 1′ to 1½′ do.	5,78,000
„ IV, ½′ to 1′ do.	7,00,000

NOTE.—Re-enumerations of class I and class II trees made over 6 compartments 8 and 10 years later showed considerably more trees in these classes.

Suppose this stocking to have been maintained and assume a death-rate of 1 per cent. per annum and volumes of utilisable timber per tree as below we get approximately :—

	No. of trees dying per year.	Estimated volume of utilisable timber per tree.	Volume from each class.	Total volume.
Class I	470	60	28,200	
„ II	2,852	35	99,720	
„ III	5,780	15	86,600	
„ IV	7,000	5	35,000	2,49,520

This shows that an average death-rate of little over 1 per cent. per annum would fully account for the normal production of dry timber estimated as above.

This figure may be checked—as two compartments were marked for dry trees in 1912-13 and again in 1917-18. The second marking therefore gave the number of trees which died in five years. This is compared with the number of trees which would be standing if the stocking remained as at the time of Working Plan enumeration:—

	Working Plan figures for No. of trees in July 1905.	Deaths in five years.	Average per cent. deaths per year.
Class I ...	1,352 ...	105	1·55
,, II ...	7,691 ...	250	·65
,, III ...	18,900 ...	724	·77
,, IV ...	22,984 ...	804	·70
		(trees under 2 ft. girth not marked).	

NOTE.—If the figures in the girth classes have increased as noted in previous page, the percentage death-rate will be smaller in class I.

The above confirms the conclusion that the death-rate does not greatly exceed 1 per cent. per annum.

The Forest Zoologist Mr. C. F. C. Beeson came to Buxa Division in the cold weather 1913-14 and again in 1914-15 and investigated the insects attacking sal trees.

He found that only one species (*Hoplocerambyx spinicornis*) is to be considered as a primary pest and that all the others are of secondary importance, attacking only diseased or weakened trees; and also that in nearly every case, the roots of dead sal trees were attacked by a parasitic fungus.

Mr. Beeson estimated the mortality from *Hoplocerambyx spinicornis* at about 10 to 15 per cent of the total mortality and suggested some control measures which have been put in force as far as possible. I believe the mortality from this insect is now considerably less than 10 per cent. of the total mortality.

(2) THE SAL ROOT FUNGUS.

History.

The sal root fungus, discovered by Mr. Beeson, was commented on by the Inspector-General of Forests, Sir G. S. Hart, in his Inspection Note, dated 28th March 1915, and by the Imperial Sylviculturist Mr. R. S. Troup in "A Preliminary Note on the sal root fungus" published as Appendix VI to Inspector-General of Forests' Note on the sal forests in Jalpaiguri, Buxa and Goalpara Forest Divisions, dated 28th April 1915.

Investigations were at once started by the Forest Botanist, Mr. R. S. Hole, and by the Officiating Imperial Mycologist, Pusa, Dr. F. J. F. Shaw. The former visited the Division in December 1916, the latter in May 1915 and on several occasions subsequently up to June 1917.

These investigations, which include the life history of the fungus, the method of infection, and preventive or remedial measures are not yet complete.

Mr. Shaw got the fungus identified at Kew in 1916 as a species new to science and named *Polyporus shoreæ* (Wake).

Appearance of diseased trees.

The signs of attack are given by Mr. Troup as—

(1) Large dark brown bracket-like Sporophores often 15" or more in diameter at the base of the stem.

(2) Cortex and sapwood of the root permeated by whitish mycelium usually in flecks or pockets producing the appearance known as "partridge wood."

(3) A characteristic odour of decaying resin from the freshly attacked tissues of the cortex which are wet and sticky.

Observation Plots.

As suggested by the Inspector-General of Forests in his Inspection Note 10 observation plots were laid out in Buxa Division and others in Jalpaiguri and Kurseong. Two of the Buxa plots have been under observation for six years and the others, all four-acre plots, have been examined for from $4\frac{1}{2}$ to $5\frac{1}{2}$ years. These plots are scattered over the whole Division and represent all types of sal forest, they

are inspected twice annually by Range Officers and a record of observations is also kept in the Divisional Office.

It was thought that these plots would give—

(*i*) the rate of spread of the disease;

(*ii*) the time taken for a tree to be killed from the first noticeable sign of attack;

(*iii*) the rate at which deaths occur associated with the fungus.

Experience has shown that it is difficult to come to any exact conclusions on the first point because the fungus may be well established in a tree before any external signs of attack appear, and although the indications at ground level are plain, they have been mistaken in some cases.

As regards (*ii*)—some trees which had sporophores on them six years ago are still living and healthy, while others died almost immediately after showing signs of infection. There appears to be no connection between the date the first signs of attack are observed and the date of the death of the tree.

It is on point (*iii*) that the observations made to date show some light. Results up to May 1921 are given on the next page:—

Plot number.	Locality.	Area acres.	Observations. From	Observations. To	Period under observation years.	Number of trees at commencement. Living	Number of trees at commencement. Infected.	Deaths associated with fungus.	Deaths from other causes.	Wind falls felled, etc.	Number of trees at end of period. Living.	Number of trees at end of period. Infected.	Average annual % of deaths. Associated with fungus.	Average annual % of deaths. All deaths.	Remarks.
1A.	Rajabhatkhawa 16	5	July 1915	May 1921	6	180	15	15	6	15 *	144	27	1·4	2·0	* 4 of these were infected.
1B.	Do. 18 ...	5	Do. ...	November 1919.	4½	117	22	15	1	3	98	22	2·9	3·1	
2	Poro 5 ...	10	Do. ...	May 1921	6	231	53	10	6	21 *	193	76	·7	1·2	* 15 of these were infected.
3	Raimatong 1 ...	4	January 1916	Do. ...	5⅓	167	36	12	5	2	149	71	1·3	1·9	
4	Panbari 2 ..	4	Do. ...	Do. ...	5⅓	169	21	...	...	2 *	167	54	...	...	* 1 of these infected.
5	Rajabhatkhawa 3	4	Do. ...	Do. ...	5⅓	207	27	20	7	1	179	38	1·8	2·4	
6	Bhutri 2 ...	4	April 1916	Do. ...	5	217	25	8	4	12 *	193	35	·7	1·1	* 1 of these had fungus.
9	Rydak 2 ...	4	October 1916	Do. ...	4⅔	237	8	13	20	3	201	14	1·2	3·1	
10	Bholka 2 ...	4	Do. ...	Do. ...	4½	381	24	23	3	3 *	352	30	1·3	1·5	* 1 of these infected.
											Average		1·25		
7	Salkumar ...	4	February 1916	Do. ...	5⅓	221	No record.		6	...	215	No record.	...	·5	
8	Borojhar 2 ...	4	Do. ...	Do. ...	5⅓	205	Do.		13	3	189	Do.	....	1·2	
												Average		1·6	

This table shows—

(1) an average mortality associated with sal root fungus of *1·25 per cent.* and *an average total mortality* of 1·6 per cent.

The areas under observation were specially selected to contain dead and dying trees—so these results are probably somewhat higher than the general averages over the whole forest ;

(2) an increased number of attacked trees at the end of the observation period considered. As above stated, it is not safe to make deductions regarding the *rate of spread* of the disease at present, since many trees may have been infected at the first inspection which were not noted as such.

Take for example plot 3. Here 33 new attacks were reported in October 1917, 20 of them on trees previously reported healthy. The reason for the attack being recognised was that sporophores were abundant just at that time. Had the inspection been made a little earlier or a little later these sporophores might have been absent and there would have been no reason to suspect that the healthy trees were infected.

An analysis of the deaths according to girth classes shows that the mortality associated with fungus is about the same throughout :—

Plot number.	Under 2'.			2'—3'.			3'—4'.			4'—5'.			5'—6'.			Over 6'.		
	Number of trees.	Deaths associated with fungus.	Deaths from other causes.	Number of trees.	Deaths associated with fungus.	Deaths from other causes.	Number of trees.	Deaths associated with fungus.	Deaths from other causes	Number of trees.	Deaths associated with fungus.	Deaths from other causes	Number of trees.	Deaths associated with fungus.	Deaths from other causes.	Number of trees.	Deaths associated with fungus.	Deaths from other causes.
1 A. B. ...	14	2	2	41	4	3	42	3	1	97	10	1	71	6	...	32	5	...
2 ...	14	1	1	28	...	1	55	2	2	68	3	1	43	3	...	23	1	1
3 ...	13	1	2	29	4	...	43	4	1	59	3	2	21	...	...	2	...	...
4 ...	11	0	0	10	...	...	37	...	...	47	...	...	47	...	...	17	...	...
5 ...	24	1	2	50	5	4	49	4	...	58	5	1	26	5	...	...	...	...
9 ...	43	4	6	75	4	6	87	2	6	26	2	2	4	...	...	2	1	...
10 ...	56	2	2	127	8	...	145	10	1	48	3	0	5	...	...	...	...	...
	175	11	15	360	25	14	458	25	11	403	26	7	217	14	...	76	7	1
Per cent. of deaths associated with fungus.	...	6·3	...	...	7·0	...	...	5·4	...	...	6·5	...	...	6·5	...	...	9·0	...

Plans showing the distribution of the trees in the observation plots were prepared, and the trees which have died are shown on these plans. As far as can be ascertained now, while the fungus does not kill all the trees in an infected area, deaths do occur in groups and the tendency is for gaps to be formed in the crop and for existing gaps to be enlarged. This point is of importance as we are making pure plantations of sal. A diminution in numbers of 1 to 2 per cent. per annum is less than the normal reduction in the number of stems in a fully stocked forest, but it becomes serious if the casualties are concentrated in groups.

The table also indicates the extreme abnormality of the growing stock in these forests. Trees from 2′ to 3′ girth are in great defect, and the smaller classes are practically absent. (This explains the observation of the Inspector-General of Forests that the majority of the stems attacked are those approaching maturity.)

This abnormality is very striking in almost all parts of the plains sal forest and makes the question of management an interesting one. Sal is being regenerated artificially now but it will be some years before the full regeneration area can be dealt with—meantime the existing crop is slowly disappearing and what remains will all mature during the next 40 to 50 years. Then there will be a period of 30—40 years during which practically no trees will become mature. During this poriod the yield will consist of overmature trees which have been retained and thinnings from the artificially regenerated crops, the oldest of which will attain maturity at the end of the period. After the close of this period the amount of trees maturing annually will still be below the normal yield inasmuch as the areas now being regenerated are less than the full amount for regular working.

The observation plots are being kept up and in time should give fuller information regarding rate of deaths and rate of spread of the disease.

A. K. GLASSON, I.F.S.

NOTES ON *SANTALUM ALBUM* IN THE CHITTOOR DISTRICT OF THE MADRAS PRESIDENCY.

The following paragraph is extracted from the Inspection notes of Mr. A. B. Jackson, Conservator of Forests, written in August 1919. The place therein referred to is a small tank on Horsleykanda, a peak in a block of hills on the Mysore frontier. The general level of the plateau around the hills is about 2,400 feet; the tank is at an elevation of 4,000 feet. The paragraph runs :—

"There is a very interesting group of young sandal on the bund of the small tank behind the bungalow. To the best of my knowledge and recollection these trees did not exist when I was last here in 1915. There are now about 50 in one clump ranging to about 10 feet high and there are 4 or 5 more at the other end of the bund.

In the immediate vicinity of the larger clump there are no trees of any kind to act as hosts. At the other end there is a large stump of Korakapillai (*Inga dulcis*) which has thrown out a large number of vigorous coppice shoots 9 or 10 inches in girth. Until recently, however, the bund has been covered with lantana. This is an ideal spot for a very interesting experiment, *viz.*, isolating the sandal with a view to discover what will happen to it when it has no host other than its own species on which to parasitise. The bund is built on sheet rock and can easily be isolated from all surrounding vegetation by cutting a trench down to the rock along its full length on the lower side and by uprooting all vegetation other than sandal on the bund and keeping it clear."

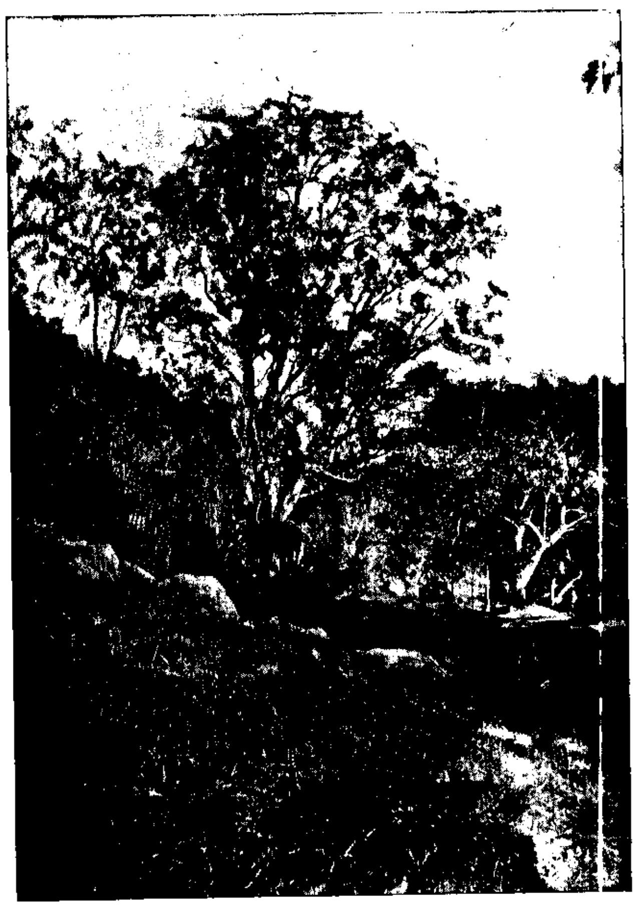
The isolating trench was cut in September 1919. In June 1920 Mr. H. C. Bennett, Conservator of Forests, visited the place and reported :—

"The experiment referred to in Mr. Jackson's note is being continued. The bund has been thoroughly isolated and is being kept clean-weeded. All sandal on it are flourishing. Last September sandal seeds, 6 at each stake, were dibbled 6′ × 6′ on

The tank at Chittoor.

Reverse side of the bund showing Sandal saplings and seedlings.

Larger group of Sandal in centre of bund.



The largest Sandal at Horsleykanda.

the bund and have been watered since and are doing well. There are no other species but sandal on the bund and no grass and the experiment ought to determine (*a*) whether sandal is an obligatory parasite, (*b*) if so up to what age it can live and thrive alone, (*c*) whether it can live and thrive when parasitic only on other sandal, (*d*) whether sandal becomes "spiked" when parasitic on itself, as suggested in Mr. Jackson's note in the *Indian Forester* of December 1919."

I paid a visit to Horsleykanda in May 1921 and took photographs which are reproduced herewith. Nos. 1 and 2 show the tank and reverse side of the bund; the latter shows clearly the trench, in which the Forester is standing, cut right down to the rock. They also show the sandal saplings. The seedlings referred to by Mr. Bennett cannot be seen clearly as they are concealed by the palmyra leaves used to shelter them from the sun. Photo No. 3 shows the larger of the two groups of sandal saplings and the latter shows that the bund is kept clean of other vegetation. In May 1921 the saplings were perfectly healthy, their leaves of a bright colour and fresh in appearance. They have grown considerably in height for they are now, many of them at least, over 15'.

So that after 20 months of isolation the saplings are quite healthy and show no signs whatever of "spike."

Sandal is not indigenous in this locality and was introduced by seed by Mr. Horsley, probably in 1873 in the compound of the bungalow near by. From here sandal has spread over the jungle all round to a considerable distance and is still spreading. The largest specimen that I could find stands by the entrance gate to the compound. It is shown in photo No. 4 and measured 34" in girth and about 30' in height in May last.

Sandal is not indigenous anywhere in the Chittoor District, but is now very abundant on the Palmaner plateau, some 30 miles distant from Horsleykanda, with a general elevation of 2,300 feet. Here the species has spread by natural means for the most part, from 3 or 4 "topes" created in about 1876 by Mr. Whiteside, then Collector. The topes themselves are now congested with

5

seedlings and saplings of sandal, so much so that it is now necessary to thin them out as the following figures will show :—

In one of them a complete enumeration was made in June of this year. The area is 14·65 acres and 17,247 sandal plants of all sizes were counted, giving an average of 1,177 per acre, or roughly, a spacing of 6' × 6'. Besides sandal, *Casuarina equisetifolia*, *Eucalyptus Globulus*, *Pterocarpus santalinus*, *Swietenia Mahagoni* and Teak have been planted, possibly at a later date. Other local tree species are also present. The proportion of sandal to all other species is approximately 4 to 1.

In another of the topes a particularly densely stocked patch was measured and separately enumerated. It measured 3 cents. On it there are 6 *Terminalia Arjuna* from 15" to 52" in girth, 1 or 2 small *Breynia* and 461 sandal, mostly under 3" in girth but running up to 18". This gives 1,53,666 sandal per acre! The sandal in these crowded topes is not very healthy looking.

Fortunately, "spike" is still unknown in the district.

C. E. C. FISCHER, I.F.S.

P.S.—It is in these topes that sandal occasionally becomes a semi-climber as reported recently by Mr. A. C. M. Littlewood.

NOTE ON THE RELATIVE STRENGTH OF SPRUCE RED-WOOD AND SPRUCE WHITE-WOOD (*PICEA MORINDA*).

INTRODUCTION.

This investigation was undertaken at the request of the Punjab Government to determine the relative strength of the red-wood and white-wood from *Picea Morinda*, particularly with a view to the possibility of using both varieties for railway sleepers. Four broad gauge sleepers of the red-wood and four of the white variety were supplied from the Bashahr Division and were received at the Forest Research Institute in the air seasoned condition.

TESTS CARRIED OUT.

Two series of tests were carried out, one to determine the spike-holding power of the wood, and the other to establish its

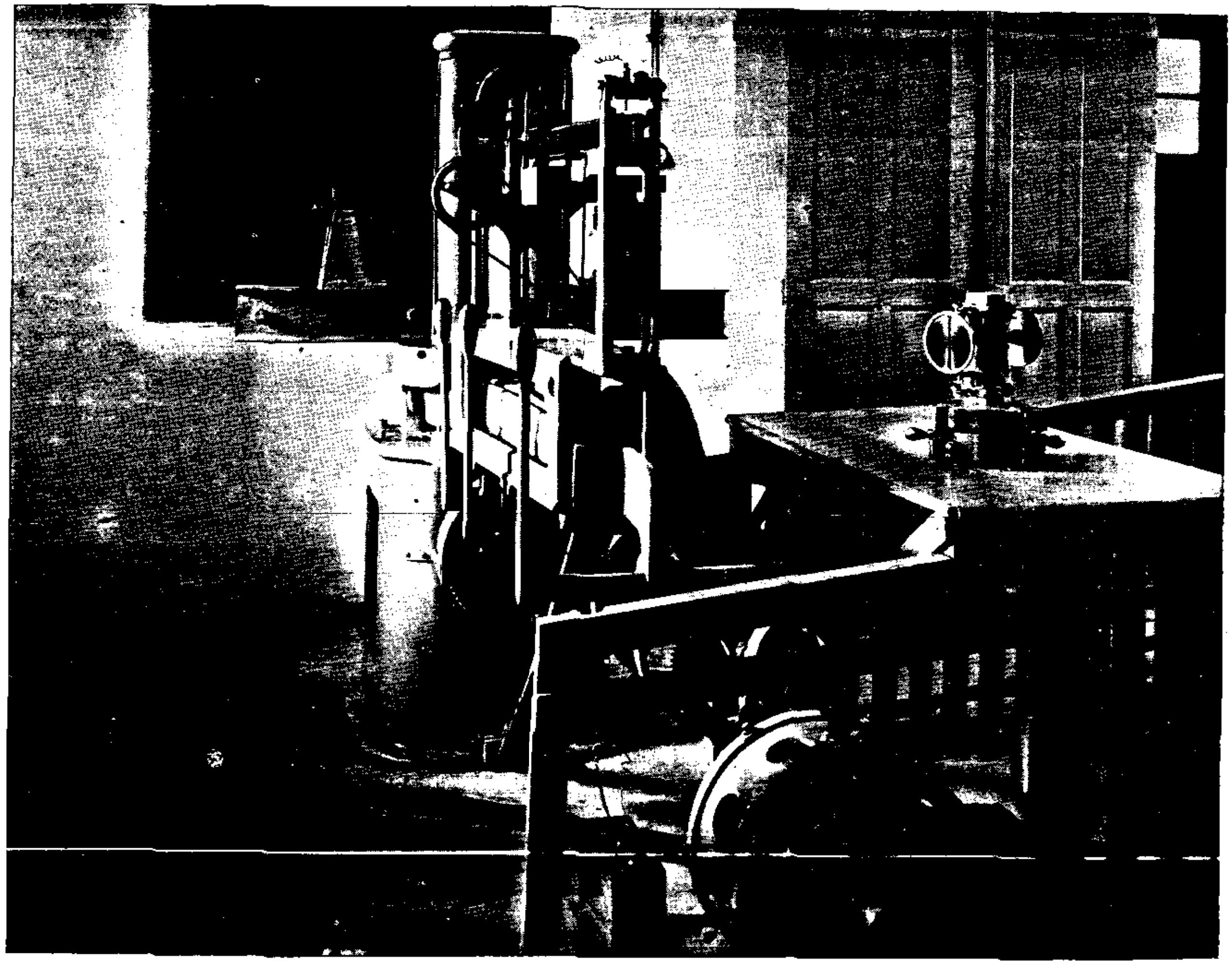


Photo.-Mech. Dept., Thomason College, Roorkee.

Olsen 30,000 lbs. Universal Testing Machine, and some appliances used in testing *Picea Morinda*.

strength, stiffness and toughness. In the former ordinary dog spikes were driven into ½ inch holes which were bored clean through the sleeper, and then withdrawn in the testing machine. The maximum force required to withdraw each spike was recorded. Twenty-two of these tests were made. The latter series of tests was conducted in accordance with standard modern timber testing practice, so that the results are strictly comparable with data obtained in Canada and the United States. Specimens were prepared 2" by 2" in section, and of varying lengths according to the tests for which they were intended. One hundred and eighty-four tests were made in this series, in addition to moisture and specific gravity determinations.

TESTING MACHINES.

Three machines were used in this investigation, one of which is shown on Plate 3. The tests of spike-holding power were conducted in a Buckton single lever machine of five tons capacity, and for the remaining tests an Olsen 30,000 lb. Universal Testing Machine and a Hatt-Turner Vertical Impact Testing Machine were employed. These are exact duplicates of the equipment used both in Canada and the United States. They have been erected and thoroughly calibrated at the Forest Research Institute within the last few months, and equipped with special power drive and gearing to obtain the correct rate of loading of the test specimens, this being necessary because the rate of loading materially affects the results obtained. It therefore follows that as the tests were carried out with the above described equipment and according to standard procedure, the results may be used to make a direct comparison between this timber and any others already tested or to be tested in the same way.

RESULTS OF TESTS.

(a) *Spike-holding Power.*

Table I presents the result of tests of spike-holding power :—

TABLE I.

No. of test.	Species of wood.	Greatest load in pounds to withdraw spikes.		No. of tests.	Species of wood.	Greatest load in pounds to withdraw spikes.	
1	*Picea Morinda* (Red).	3,669	Average moisture content 14·1 per cent. of weight of oven dry wood.	12	*Picea Morinda* (White).	* 1,714 (ab)	Average moisture content 17·6 per cent. of weight of oven dry wood.
2	" ...	3,260		13	" ...	2,386	
3	" ...	4,261		14	" ...	2,995	
4	" ...	3,605		15	" ...	2,895	
5	" ...	4,139		16	" ...	2,773	
6	" ...	3,970		17	" ...	2,025	
7	" ...	2,562		18	" ...	3,120	
8	" ...	2.977		19	" ...	2,598	
9	" ...	3,191		20	" ...	2,270	
10	" ...	3,025		21	" ...	2,096	
11	" ...	2,656		22	" ...	* 1,820 (ab)	
	Average ...	3,392			Average ...	2,573	

* Defective test, not included in average.

It will be noted that while the figures obtained for red-wood are much higher than for white, the moisture content of the latter was higher than that of the former. This additional moisture content of itself materially reduces the spike-holding power. However, though no figures are as yet available for converting spike-holding power to corresponding values at a different moisture content, it is evident that the difference is considerably greater than can be accounted for by this means, and that in this respect the red-wood is superior.

STANDARD STRENGTH TESTS.

The results obtained from the Standard tests are shown in Table II. For convenience in making comparisons a third line has been added showing the values for red-wood expressed as a percentage of the corresponding values for white-wood. From this it will be seen that the former is in every case the stronger wood of the two, but again the moisture content of the white-wood is slightly greater. This difference is, however, so slight (only 1 per cent. of the weight of the dry wood), that even were correctionfactors applied the advantage is still on the side of the red-wood.

TABLE

Summary of results from tests for

Species.	Seasoning.	Specific Gravity on weight when oven dry and on volume when tested.	Weight per cubic foot as tested.	Moisture content based on weight of wood when oven dry.	STATIC: Fibre stress at Elastic limit per square inch.
1	2	3	4	5	6
			Pounds.	Per cent.	Pounds.
Spruce (white-wood) *Picea Morinda.*	Air dry	·402	28·8	15	5,415
Spruce (red-wood) *Picea Morinda.*	Air dry	·436	31·0	14	6,142
					Comparison
Spruce (red-wood) taking white-wood 100 per cent.	...	108	108	93	113

II.

Mechanical and Physical properties.

Bending.			Impact Bending.			
Modulus of rupture per square inch.	Modulus of Elasticity per square inch.	Work in bending per cubic inch of specimen to Elastic limit.	Fibre Stress at Elastic limit per square inch.	Modulus of Elasticity per square inch.	Work in bending to Elastic limit per cubic inch.	Height of drop of 50 lbs. hammer causing complete failure.
7	8	9	10	11	12	13
Pounds.	1,000 Pounds.	Inch Pounds.	Pounds.	1,000 Pounds.	Inch. Pounds.	Inches.
8,778	1,452	1·15	11,736	1,893	4·06	21
10,261	1,584	1·36	12,817	2,202	4·23	26
of Strength.						
117	109	118	109	116	104	124

TABLE

Summary of Results from tests for

COMPRESSION PARALLEL TO GRAIN.			COMPRESSION PERPENDICULAR TO GRAIN.
Compression stress at Elastic limit, per square inch.	Crushing strength at maximum load per square inch.	Modulus of Elasticity per square inch.	Compressive stress at Elastic limit per square inch.
14	15	16	17
Pounds.	Pounds.	1,000 Pounds.	Pounds.
3,038	4,487	2,058	668
3,140	4,614	2,150	678
103	103	104	101

II.

Mechanical and Physical properties—*(concluded).*

HARDNESS.		SHEARING PAR'L TO GRAIN.	TENSION PERPENDICULAR TO GRAIN.	
Load required to imbed a 0·444 inch sphere of steel to one half its diameter.		Shearing strength per square inch.	Tensile strength per square inch.	Consignment.
Radial Tangential and Diagonal surface.	End surface.			
18	19	20	21	22
Pounds.	Pounds.	Pounds.	Pounds.	
467	718	1,023	381	
594	740	1,213	422	
127	103	119	111	

Explanatory Note to Table II.

(a) Strength.—The strength of the wood against different types of stress is best indicated by the results found in columns Nos. 6, 7, 14, 15, and 17 to 21, inclusive of Table II.

(b) Stiffness.—The stiffness is shown in columns Nos. 8, 11 and 16 of Table II.

(c) Toughness.—This property of the wood is proportional to the results found in columns Nos. 9, 10 and 12 of Table II.

CONCLUSIONS.

One great advantage of conducting the tests in the manner here adopted is that it affords a means of comparing the varieties as tested not only with each other, but also with any other species tested according to the standard methods. From the above results it is possible to assert that in spike-holding power, strength, stiffness, toughness and hardness, spruce red-wood is superior to spruce white wood. Referring to the specific gravity of the two varieties it will be seen that this is what might have been expected, the red-wood being the denser of the two. But it is possible to assert further from comparison with results already obtained in Canada and the United States, that both red and white-wood, *(Picea Morinda)* are of about equal strength with black spruce (*Picea moriana*) and red spruce *(Picea rubens)*, two of the best spruce woods grown in the eastern portion of North America.

L. N. SEAMAN,
Officer in charge Timber Testing Section.

THE INSECT PESTS OF REGENERATION AREAS.

Publications of the Forestry Commission. Leaflets 1—4: (1) Pine Weevils, (2) *Chermes Cooleyi,* (3) the Pine Shoot Beetle, (4) The Black Pine Beetle, London, 1920—1921.

The recent issue of leaflets by the Forestry Commission on the principal insect pests of conifers in the United Kingdom illustrates two factors of consequence in forest entomology. Firstly the importance attained by the normal insect fauna of a

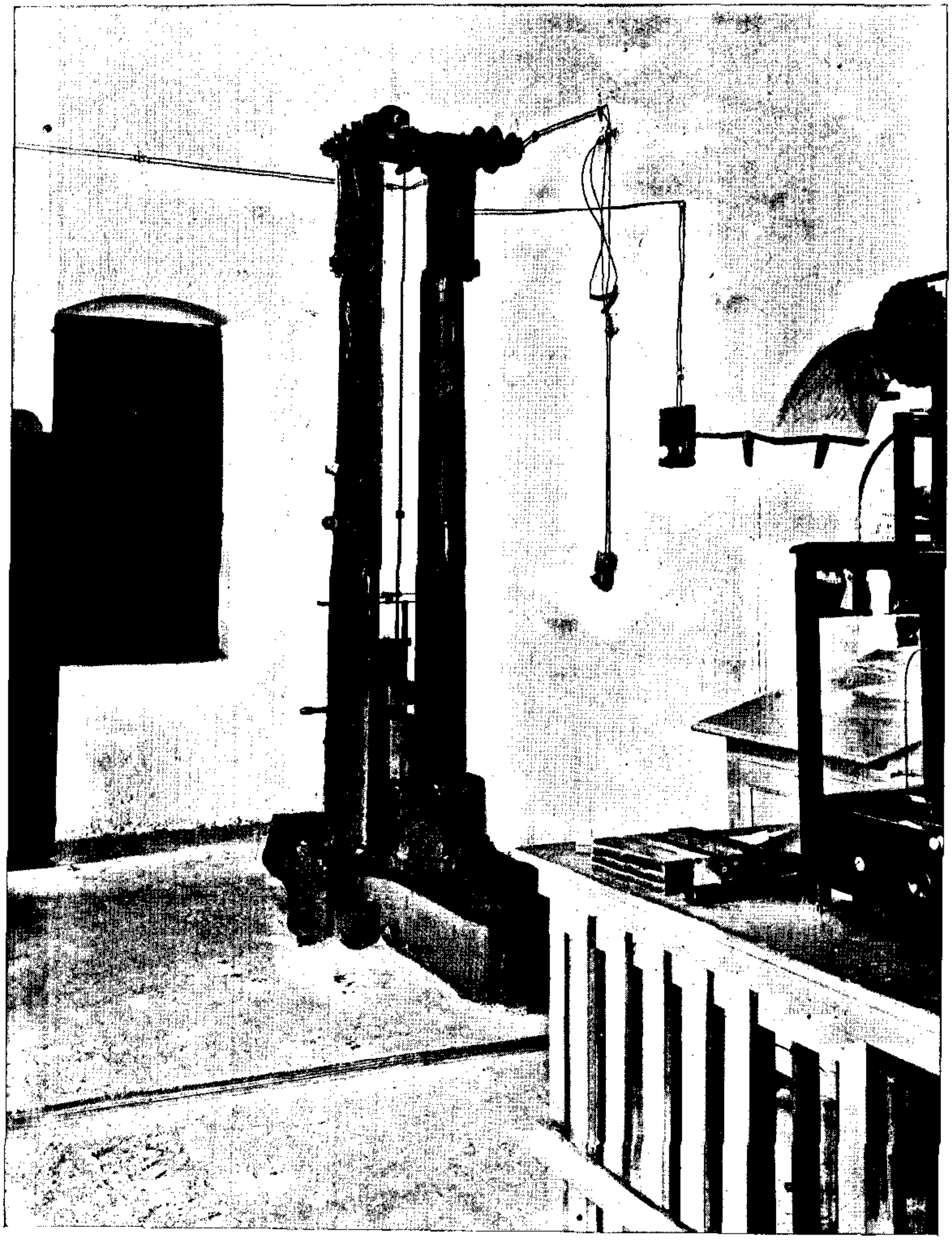


Photo.-Mech. Dept., Thomason College, Roorkee.

Hatt–Turner Impact Testing Machine used in testing *Picea Morinda*.

[To face Table II.

tree, when an attempt is made to establish a forest crop by artificial regeneration and in stands that differ from the natural occurrence of the species comprising the crop. And, secondly, the inference that the standard methods of control, which should be applied to such pests, were devised in the early years of European forest management and that no modifications, productive of economy in labour or supervision and facility of application, have since been produced.

Thus for the Pine Weevils *Hylobius* and *Pissodes* we are told ......" there are no known means of preventing attacks," but they may be controlled by uprooting of stumps and roots after felling, or treatment with antiseptic and fire. (2) Dressing the stems of young plants with insecticides. (3) Trapping in partially buried billets and branch-wood of pine and spruce, involving frequent inspection of the traps. (4) Hand-collecting.

" So far as our experience goes, the methods of trapping by bark—or bait traps and of collecting by hand are undoubtedly the most efficient of all the methods of control available against *Hylobius*."

For the Pine Shoot Beetles *Myelophilus* the control measures advised are: (1) Systematic thinning of brood-trees. (2) Barking of logs felled during the winter and burning of branch-wood before midsummer. (3) Correct choice of species. (4) Trap-trees felled in winter and barked in early summer, and felled in summer and barked in winter.

For the Black Pine Beetles (*Hylastes*) the measures advocated are: (1) Burning of attacked plants. (2) Selection of healthy plants and careful planting. (3) Trapping in partially buried pine logs involving frequent inspection of the traps.

In the Himalayan coniferous forests, pests of essentially similar habits exist, *e.g.*, the Pine Weevils (*Hylobius* and *Cryptorrhynchus*), and the Pine Shoot Beetles (*Ips*, *Polygraphus*, *Carphoborus*, etc.)*.

* No species *Hylastes* is at present known from the Himalayas. The two species described by Stebbing as *Hylastes himalayensis* and *H. longifolia* are not Scolytids but Cossonids of the genus *Brachytemnus*.

Their existence suggests that damage of the same type will become more prevalent with the extension of concentrated and artificial regeneration areas in the mountain pine and fir forests. It is, moreover, necessary to face the fact that, in all probability, *effective control will not be obtained, except by the utilisation of such intensive measures as clearance of the felling-area and the establishment of a sequence of traps.*

The question of protecting regeneration areas and young crops is one that is becoming prominent among the problems of present-day forestry in India, not only in coniferous woods, but in mixed broad-leafed forests, where conditions are wholly dissimilar to those of Europe. Investigations in this field are projected under the programme of the Forest Research Institute but the relative importance and urgency of the various problems can be determined most adequately by the divisional staff. Information on the form and extent of insect damage in young crops is badly wanted, and it is hoped that an expression of the requirements of provinces for research in this direction will be forthcoming by the time that the Forest Entomologists now under training are available for work.

C. F. C. B.

LAYS OF THE WESTERN GHATS.

V.—THE COMBAT.

The Sun rose cold on Potoli Hill
In the forest below the mist hung still,
Up on the ghat where three roads met
A few red dogs were lingering yet,
Noiselessly brushing the herbage wet.

Daylight waxing by slow degrees,
Silvered the stems of the Jamba trees,
As the Sun rose high above Potoli
His fitful shafts reached far Fansoli
Lighting the jungles in dark Virnoli.

Beyond Fansoli some furlongs ten,
The hill drops deep to the Nagzari glen,
The village *shikari*, cunning and keen
Seldom, the villager never, I ween,
Explores the heart of that vast ravine.

On the Kulgi slopes the day grows hot
In that dim valley the Sun is not,
The voice of the jungle calls again,
So leave you a while the haunts of men
And follow me down the Nagzari glen.

In peaceful haunt by a jungle pool,
Leisurely cropping the grasses cool
Far below in the heart of the wood,
Seeking rest and finding it good,
An old and lone bull bison stood.

His great horns curved in a massive sweep,
The mighty shoulder was broad and deep,
His form showed huge in the forest dim,
A ponderous weight for so light a limb
And that chiselled hoof so small and trim.

Such was the monarch of that place—
Noble sire of a noble race.
For fifteen years the herd had known him
But slow and sure had nature shown him,
The younger bulls would no longer own him.

Now in his veins the blood ran slower,
The tide of life ebbed ever lower
But peace was in his mild brown eye.
Peacefully, leisurely give him to die
In his own loved nook let his old bones lie.

It was not to be. In that jungle dim
A wary tiger was stalking him,
Twitched his tail with kindling ire
His eyeballs glowed like coals of fire,
Foreboding death and murder dire.

His muscular chest was squarely set,
Sleek was the full round shoulder yet,
But the brindled flanks were gaunt and slim
For the cattle famine was pinching him
And the drawn-back lips were cruel and grim.

As the bison stooped to the water clear,
The unguarded posture cost him dear—
Of a sudden a yellow meteor flashed
As the sinewy Tiger outward dashed,
On the old bull's neck his whole weight crashed.

But not unscathed would he win the prize,
For the aged bull was thrice his size,
Up he staggered in blood and foam,
With hoofs set deep in the sandy loam,
And the rugged horns went charging home.

Not e'er noon was the battle o'er
And the Tiger's flanks were red with gore,
But the bison's throat had bled apace,
The great cruel paw had gashed his face,
And held him low in a fell embrace.

* * * *

A kite soared round in a cloudless sky
The vultures had flown to their roosting high,
Signs of strife and death were none,
A peaceful valley the Sun shone on
But a grand old Bull was dead and gone.

GEM.

A FOREST DEPARTMENT ALPHABET.

A's the Accountant-General, I ween,
So endeared to our hearts, you know what I mean.

B the Brass Hat, who we all wish were dead
When his head-gear becomes too small for his head.

C is a Clerk, a curious creature,
A mechanical brain is his salient feature.

D's the Division that's placed in our charge;
Its staff is too small and its size much too large.

E is the Elephant; Lord! what a load
She carries through jungles with never a road.

F is the Form, how I hate the mere sight,
Which we fill up all day and then never get right.

G is for Girdling, which never seems done;
A suitable job for a Turk or a Hun.

H is the Hate which we hand out at dawn,
As we turn out of bed with an oath and a yawn.

I's for Inspection, a tedious game;
For Incompetence too, often shown at the same.

J is the Juggins who does all the work;
His reward is the thanks of the many that shirk.

K is for Klaptrap, I spell it that way,
Resolutions and Minutes allow it free play.

L's the Lessee, who makes fifty per cent
And fools us all round to the top of our bent.

M is the Mileage we seldom get at—
Oh! ye martial policemen, what think you of that?

N is the Neap, whose counting we take,
But it's usually burnt by the time the rains break.

O's the Objection, all hoary with years,
Which we greet as a friend every time it appears.

P is our Pay, so pitifully small
It's a wonder to me we get any at all.

Q the great Question, the popular moan,
"How the deuce can I live on my pension alone?"

R's a Return, there are several kinds,
Both annual and monthly, to please little minds.

S is for Sanction, a magical word,
Which removes an Objection as soon as it's heard

T's for T. A. No, we never think of it
As additional income or source of much profit.

U's Undergrowth, with consequence dire,
Which in Burma we raise by protection from fire.

V is the Value our services render,
Which in general receives recognition so slender.

W's Weather, the quality sent
Has significance rare for the man in a tent,

X the initial I've written below;
My own I'm afraid to append, don't you know.

Y is a symbol which haunts one and all—
Y the deuce did I come out to Burma at all?

Z is for Zero, or nothing (or less),
Which in some people's minds denotes our success.

X.

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THE ARTIFICIAL REGENERATION OF SAL IN GORAKHPUR.

INTRODUCTIONS.

In 1914 Mr. Marriott's Working Plan came into force for the Gorakhpur Division and involved, for certain areas, a complete departure from established practice, in that clear fellings were prescribed for certain very considerable areas. The success of the method depended on the certainty of regeneration. This is obtained from the coppicing up of the very large number of small poles, saplings, and suppressed advance growth which exist over the greater part of the area so treated; and where a sufficient number of these small poles exist, it can be said that regeneration is assured. Originally it was prescribed that where such poles did not occur a certain number of old trees were to be left as seed bearers and these would restock the blanks. It was soon decided that this was not a satisfactory way of obtaining the necessary regeneration, and this idea was given up. It then remained to restock these blanks artificially, and it is proposed in this article to trace the history of the attempts to do this, from their inception

in 1913 to the present year, when success would appear to be assured. The blanks are ordinarily of two kinds. Small blanks inside the forest where, owing frequently to density of cover or water-logging, or other conditions, regeneration is deficient, and secondly, more considerable areas along the gentle slopes leading down to streams, on which the best quality sal of the division grows, but where regeneration is nearly always lacking or deficient.

The locality in which the sal grows here differs very considerably from that of the sub-montane districts. The country is flat, the rainfall less, but the soil probably considerably more moist in that the water after rain lies on the ground till it soaks in, there is very little run-off, and, in fact, during the rains, almost the whole district is liable to flooding. The cold weather is short and frost, although it does sporadic damage, probably need not be taken into account as a factor likely to vitiate the success of regeneration in the open. For this reason alone Gorakhpur differs widely from almost all other sal areas in the U. P.

It is not necessary here, as in most forests in India, to keep the expenses of formation down to a negligible quantity, on account of the extremely high value of all forest produce. Everything is saleable down to the leaves. The experiments have been carried out in the Ramgarh-Tilkonia forests, with a sal area of 5,714 acres, mostly old coppice with standards now growing up. The quality class of the sal is low, probably third, and the large trees are few. An idea of the value can be taken from this year's sales, for the clear felled coupes. Everything is clear felled and the area cleaned entirely by the contractors, and when work is finished presents an area of sal stumps cut from 4" to 6" above ground level, every bush and shrub cut back, and the ground literally cleared, even of leaves. The stock consisted on the average of just under 30 trees to the acre above 3' 1" in girth and only 0·19 tree over 5' 5" in girth to the acre. The remainder being mostly poles, the area is therefore lightly stocked with timber trees. The sale price averaged Rs. 756 per acre, which amounts to Rs. 18·9 per acre for the whole area of sal forest. One small area in which, though not fully stocked, there were a considerable number of

trees above 3′ in girth fetched Rs. 2,150 per acre, whilst an area of the new crop raised from the clear fellings, and which consisted of a strip 50′ wide comprising 2 acres of 8 year old, 2 of 3 years old, and *2 of 2 years, 6 acres in all, averaged Rs. 56 per acre. It is therefore clear that money spent on artificial regeneration is* likely to be spent very profitably.

Patch sowings were attempted *in situ* in the forest in 1912. They were a total failure.

PART I.

RAMGARH NURSERY.

In June 1913 it was decided to make a nursery in the Ramgarh Rest-house compound, 7 *miles by* pucca road from Gorakhpur, with a view to attempting to rear sal under nursery conditions. An area of *2 × 2½ chains was selected on the site* of an old fruit garden, and the ground was hoed up to a depth of about 12″; all shrubs, etc., dug out, the clods broken up and grass roots removed. This area was then divided into two equal parts. The first part was divided into parallel strips 5′ wide with intervening pathways 2′ wide. The second part was left untouched. From 25th to 30th June after the rains had broken and when light rain was falling, healthy looking ripe sal seed was sown in both parts, being covered with about ¼″ of earth. The seed germinated simultaneously and well in both parts, but a number of seedlings died from the attacks of Cock-chafer grubs. In the first half (*i.e.*, that divided *into strips) weeding has been* done twice during each rains ever since. The results of measurements taken in July 1921 are as follows :—

Age 8 years. Highest sapling 14′ 5″. Girth 8″.
Average sapling. Height 8′ 9″.

The second half was sub-divided into two parts, one of which was regularly watered and weeded from December 1913 to June 1914, *whilst the other was weeded but not watered, with* the result that in June 1914 the watered plants were half as high again as the unwatered ones. On the break of the monsoon, however, the unwatered plants shot up very rapidly

and by the end of September were as high as the watered ones. Thereafter weeding continued but watering was abandoned.

In June 1915 root and shoot cuttings were made of a number of these seedlings, the root being cut off with a length of 1′ 6″ and the shoot 1½″, and these were transplanted in the nursery, being 2 years old. After a week's time these began to give out new shoots, whilst in December 1915 some were dug up when it was found that they were giving out new roots at the point where the old root was cut off. These results being encouraging a good many seedlings were treated in this way and were planted out in the young clear felled coupes 1, 2 and 3 and this work was decided on on a larger scale. In the cold weather of 1916 the area of the nursery was increased to 5 acres, which was fenced all round. This time the beds were prepared as follows: In the cold weather of 1916 the ground was hoed up to a depth of 1½′ and was left. In the beginning of June 1917 it was again worked over and prepared as already described for the first nursery except that the beds were 4′ wide, the paths 2½′ and the latter were raised, forming low bunds. The seed was sown in furrows 1′ apart made with a 3-pronged wooden fork. The seeds were placed about 3″ apart in the furrows and as the monsoon had not yet broken the seeds were covered with ½″ of soil and watering was done morning and evening. The sowing was still going on when the monsoon broke, and it was found that of the seed sown before the rains broke from 50 per cent. to 70 per cent. germinated, whilst that sown after the rains had begun to fall the percentage of germination was as high as 90 per cent. to 95 per cent. From July to November 1917, 6 malis and a number of coolies were employed continuously weeding and hoeing, whilst the sickly plants were taken out in sufficient quantity to afford a growing space of from 6″ to 9″ to each seedling. In the years that followed weeding was done during the rains. In 1919-20 a certain amount of damage was done by frost whilst in the hot weather of 1921 most of the leading shoots were scorched back from 6″ to one foot in the very exceptional hot winds of that year. In June 1917 when sal seed was being collected for sowing and

as the monsoon had not yet broken two beds were prepared by clearing and hoeing up the ground to a depth of about 5", and the seed was put to keep in these beds. When it was taken out a considerable quantity was left behind in each case. This germinated. One bed was in the shade of a sal tree and the other in that of a mango. The shade is pretty dense The seedlings in the shade of sal all died back, and now no longer exist. Those under the mango sprung up quickly and did not die back. The highest of them is now some 6' and the average about 3' and the age 4 years. They are, however, "whippy" in appearance and are not sturdy.

It is, at this point, not without interest to compare the growth in the original nursery with that in the big nursery afterwards established. The principal difference between the two is that the old nursery was dug up to a depth of 1' just before the sal was sown whilst the new one was dug up to a depth of 1½' in the cold weather preceding the sowing of the seed, *i.e.*, the turned soil was left exposed for some months before sowing.

Nursery.	Treatment.	Age.	Highest sapling.	Average sapling.	Average rate of height growth of average sapling per annum.
Old Nursery ...	Dug to 1' and sal sown both in June.	8	14' 5"	8' 9"	1' 1⅛".
New Nursery ...	Dug 1½' in December, sal sown in June.	4	9' 2"	5' 8"	1' 5".

The bunds between the beds were not so marked in the old as in the new nursery.

The area of the new sal nursery is 5 acres. The costs since 1917 come to Rs. 97-7-6 per acre exclusive of the cost of fencing-wire and the pay of 6 malis for 5 months in 1917. If the malis' pay is included the cost is Rs. 133-7-6 per acre.

One very marked feature is that on two sides the nursery is bounded by forest. The sal in the beds nearest the forest have not done well and are in many cases not more than 1' to 1½' high,

when a distance about equal to the height of the old trees is reached away from them the height of the young sal considerably and progressively increases. There is thus a well marked line of high seedlings which even follows angles in the old forest, and which advances or recedes slightly according to the height of the old trees. There is no difference in the soil, or in the former usage of the land to account for this, but it is strikingly marked.

The sal was sown in June 1917. In January 1918 when the seedlings were mostly from 6" to 10" high, two average healthy ones were dug up. The root was perfectly straight downwards in each case. With neither was the root completely extracted, but in each case it was very nearly so. One root was 4' 6" and the other 6' long.

PART II.

ARTIFICIAL REGENERATION.

In the Open Forest.

As related in Part I when there appeared to be hopes of success in restocking blanks by means of root and shoot cuttings, the area of the nursery was increased to enable a large number of plants to be reared, with the object of planting them out in the forest. The root and shoot cuttings were planted in pits about 10' apart. The pit was about 1' 6" deep with a diameter of 6"—7". When the rains had well broken and the pits were full of water, they were cleaned of leaves and mud, etc., and the root and shoot cuttings were put in, great care being taken that the bark of the roots was uninjured and that the root collar coincided with the top of the soil. A circular patch of the grass was cleared with a radius of 2' round each plant.

In coupe 1 in March and April 1916, 36,000 pits were dug on an area of 130 acres and 2,000 pits on an area of 9 acres. In the 36,000 pits root and shoot cuttings were planted from the surrounding forest, fire-lines, etc. Only 3 per cent. of these survived there first year. The 2,000 pits were planted up with 3 year-old plants from Ramgarh Nursery. In August and September 1916, July and September 1917, and August and September 1918 grass was

cleared off from around them. Since then they have been left alone. In July 1921 their measurements were as follows:—

Nursery.	Age.	Highest seedling.	Average seedling.	Average height growth of average seedlings per annum.
Planted in Coupe I ...	3+5	2′ 8″	1′ 7″	3¾″
Transplanted in Nursery.	2+6	7′ 4″	5′	10″

The total cost for the 2,000 pits is Rs. 39-6-9.

In coupe 3, 28,000 pits were dug in May 1919 as in coupe 1. Only nursery plants were used: 7,000 1-year old plants and 21,000 2-year old ones. Grass was cleared in August and October 1919 and again in January 1921. Of the 7,000 1-year old plants only 10 per cent. survived, they have died back each year and are becoming bushy. Their age in July 1921 was 2+2 years. The highest seedling 1′ 7″ and the average 1′. Average growth per annum of average seedling being 6″. The total cost was Rs. 380-13-0.

In coupe 2, in April 1917, 3,000 pits were dug and at the break of the rains 2-year old seedlings were put in from Ramgarh. In December 1917, 33 per cent. were killed by frost. The next year nothing was done and most of the plants were killed by grass and soft wood growing over them. A few survive in the more open places.

Age 2+4 years. Highest seedlings 2′. Average seedling 1′ 3″. Average growth per annum of average seedling 3¾″. Cost Rs. 88-12-11. In coupe 10, 1,000 2-year old plants were planted out in an area of 2 acres in June 1919, with the idea of testing the effects of planting under shade. The shade is not very dense as the canopy is considerably interrupted. About 75 per cent. gave out new shoots, but by May 1920 they were all dead. Expenditure Rs. 9-3-0.

The root and shoot cutting method of planting out has now been given up, and attempts have been and are being made at sowing *in situ* in the forest. Two areas were chosen which are typical of those areas near the banks of streams where regeneration is most deficient, the difference between the two being that one, in coupe 2 Tilkonia, is in a clear felled coupe and would involve sowing in

the open, whilst the second was in coupe 10 involving sowing under shade. The sowing in the open should give results enabling regeneration to be established after failure had occurred in a clear felled coupe, whilst the sowing under shade would enable success to be assured before the clear felling took place and would enable the whole of the new crop to grow up in a homogenous mass. Sowing in coupe 10 under shade meant sowing 5 years before the fellings. This was considered to be likely to be too short a time and a year later a similar area was taken next door in coupe 16 or 10 years before the fellings. These two may conveniently be taken together. The overhead cover may be considered light in both cases, resembling more a very light group felling than thinning. The canopy is noticeably interrupted in places. Two acres were taken in coupe 10, on the gentle slopes of the Tura Nala and the strips, 3′ wide with 10′ intervening and dug to 1′ were laid down the slopes. It was found that the strips tended to become water-courses and game tracks and in 1920 when coupe 16 was prepared the strips were made 5′ wide with 15′ intervening and dug one foot deep, along the contours on somewhat flatter ground. In each case the digging was done at the time of sowing, and strips were weeded in their first rains, and again in January 1921 owing to winter rains. The growth of weeds is not great. In coupe 10 from 70 per cent. to 75 per cent. of the seed germinated. Of that which germinated about 30 per cent. has survived up to July 1921. In coupe 16 only about 60 per cent. of seed germinated, the rains of 1920 being scanty and of those which germinated again about 30 per cent survive. The seedlings in coupe 10 put on practically no height growth in their second year. This history of these two experiments is given in tabular form.

Coupe.	Age.	Area.	Total Cost.	Highest seedling	Average seedling.	Average annual height increment.
			Rs. a. p.			
Coupe 10	2 years	2 acres	20 2 6	1′	10″	5″
Coupe 16	1 year	4 ,,	47 9 0	1′	8″	8″

The area taken up in coupe 2 Tilkonia is 5 acres in extent. The ground slopes very gently. The coupe was clear felled in 1915-16 and the sowing was done in 1919. There was little sal

regeneration on the area taken but a dense growth of miscellaneous trees and *munj* grass. *Five strips were taken, each 1 chain wide* about 500′ long with an intervening space of 25′ to 30′ in which nothing was done. The strips lie along the contours, running North and South. In each strip sal was sown in bands 3′ wide across the strip with 3′ intervening in which the soil was worked and weeded. Two strips were dug to a depth of 1½′ in March. The soil was left exposed and again worked over in June when the seed was sown. The *remaining 3 strips were dug over to a depth of 1′* in June only. In each case stumps were dug out, the soil was well broken and grass roots extracted. The strips were weeded in July 1919, weeded and hoed in August 1919, and weeded in September 1919. In July and August 1920 light weeding was again done. In 1919 when the seed was sown the rains were late and watering was resorted to from 14th to 27th June. The plot has had unfavourable weather in that the rains of 1920 were short. A very unusually sharp frost occurred in the cold weather of 1920-21, whilst the hot weather of 1921 was the worst within living memory. A strong "Loo" or hot wind blew on 18 days in May and June which scorched the leading shoots, an almost unique occurrence in this district. The plots have grown up entirely under forest conditions. The area is not fenced in any way. It lies along the boundary of a grass area open to grazing and illicit grazing has done much damage, the cattle being partial to the tender shoots of the young sal. Nilgai and pig have also done damage. About 75 per cent of the plants that germinated exist, making a dense mass of seedlings. The plants are healthy in appearance and the stems have assumed in many cases the "Carroty" appearance of the healthy sal sapling. The total cost of the 5 acres is Rs. 168-9-7 being about Rs. 33-11-0 per acre in all. The results are tabulated.

Plot.	Treatment.	Age.	Highest plant.	Average plant.	Average annual height increment.
Sub-plots 1 and 2.	Dug to 1½′ in March. Re-dug and seed sown in June.	2 yrs.	7′	4′ 3″	2′ 1½″
Sub-plots 3, 4 and 5.	Dug to 1′ and seed sown in June.	2 yrs.	3′ 5″	2′	1′

It is claimed that digging up the ground to $1\frac{1}{2}''$ in the cold weather apart from the growth of sal, has the following advantages :—

1. The ground is then soft, deep digging is therefore much easier and cheaper.

2. The soil is exposed and ærated.

3. On well turned soil the hot weather kills the roots of the grass and the subsequent weeding required is less and cheaper in consequence.

PART III.

CONCLUSIONS.

The results of all the experiments are tabulated to enable comparison to be made.

TABLE.

No	Place.	Treatment.	Age in July 1921.	Height of highest plant.	Height of average plant.	Average annual height increment of average plant.	
1	Old Nursery	Old garden site. Dug to 1′ in June. Sal sown and weeded when necessary each year.	8 years ...	14′ 5″	8′	1′ 1⅛″	
2	New Nursery	Dug to 1½′ in Dec. Beds prepared and seed sown in following June.	4 years ...	9′ 2″	5′ 8″	1′ 5″	
3	Coupe I 130 acres.	Root and shoot cuttings from forest in 36,000 pits. Only 3% survived their first year. Since lost sight of.	...	...	...	...	
4	Coupe I 9 acres.	Root and shoot cuttings from old nursery. Grass cleared in 1916-17 and 18 when necessary.	3 years in nursery and 5 in forest.	2′ 8″	1′ 7″	3⅘″	
5	Old Nursery	Root and shoot cuttings of 2 years old nursery plants, transplanted in the nursery, weeded when necessary.	2 years in nursery and 6 in transplants.	7′ 4″	5′ 0″	10″	
6	Coupe 3 ...	7,000 root and shoot cuttings of 1 year old nursery plants. May 1919. Grass cleared August and October 1919 and January 1921.	1+2 years ...	Very sickly, not measured.	...	...	10 per cent. survived.
7	Coupe 3 ...	21,000 root and shoot cuttings 2 years old nursery plants. May 1919. Grass cleared August and October 1919 and January 1921.	2+2 years ...	1′ 7″	1′ 0″	6″	33 per cent. survived.
8	Coupe 2 ...	3,000 root and shoot cuttings of 2 years old nursery plants. June 1917. Grass cleared in rains of 1917. Nothing more done. A few survive in open places. Measurements are of these.	2+4 years ...	2′ 0″	1′ 3″	3¾″	
9	Coupe 10 ...	1,000 root and shoot cuttings of 2 years old nursery plants put in shade in June 1919.	...	None survive	...	...	

No.	Place.	Treatment.	Age in July 1921.	Height of highest plant.	Height of average plant.	Average annual height increment of average plant.	
10	Coupe 10 ...	Sowing in strips *in situ* in the forest under fairly light overhead shade. Ground dug 1′ deep in strips. Weeded regularly. Unfenced. Forest condition. Strips down slope.	2 years ...	1′ 0″	10″	5″	30 per cent. survive.
11	Coupe 10 ...	Sowing in strips *in situ* in the forest under fairly light overhead shade. Ground dug 1′ deep in strips. Weeded regularly. Unfenced. Forest condition. Strips along contour.	1 year ...	1′ 0″	8″	8″	30 per cent. survive.
12	Coupe 2, plots and 2.	Sowing *in situ* in forest in the open, in strips dug 1½′ in March, seed sown in June. Unfenced. Forest condition.	2 years ...	7′ 0″	4′ 3″	2′ 1½″	Dense crop.
13	Coupe 2, plots 3, 4 & 5.	Dug deep when seed was sown, otherwise as in 1 and 2.	2 years ...	3′ 5″	2′ 0″	1′ 0″	Do.

These then are the results of the Ramgarh-Tilkonia batch of experiments. Others are in progress elsewhere in the division but have not yet reached the "article" stage. The results have been given for everything, failures as well as successes, and it remains for each person interested to draw his own conclusions from them. Certain justifiable deductions appear to emerge.

(1) Sal seed possesses far greater vitality than it is given credit for, if, when sown, it is covered with from $\frac{1}{4}''$ to $\frac{1}{2}''$ of earth, especially if that earth is slightly damp. This comes out on several occasions in the foregoing pages. It may also be mentioned here that in 1921, 15 acres were sown with sal in another range. Of this about half was sown on 21st June. Heavyish rain having fallen from the 19th to 24th, the seed was covered with soil, the wings being exposed. This germinated at once and very well. From 24th June to 8th July there was a break with very little rain. The remainder of the area was sown on 26th June during this break. The germination was exceedingly disappointing, not more than 15 per cent to 20 per cent. This however all came right at the beginning of August when most of the seed which had not germinated to date came up. Some of this lay in the ground from 26th June to 4th August before it germinated.

(2) Root and shoot cuttings planted out in the forest have failed. Numbers 3 to 9 of the table demonstrate this sufficiently well. In all cases in the forest the root and shoot cuttings have died back every year and are not happy. That sal can be propagated in this way is however shown by No. 5. These results could probably be duplicated in the forest if the soil were worked very intensively. In this case, however, the plants would have to be planted close together, to allow a sufficient number of survivals after Nilgai and illicit cattle had

taken their toll and even then the ones reared in the nursery do not compare with the seedlings in No. 12 sown in the forest.

(3) When sowing the sal the soil should be worked in the preceding cold weather to *at least* $1\frac{1}{2}'$ in depth. Comparison of Nos. 1 and 2 in the nursery and 12 and 13 in the forest show this. In No. 12 the best plants all occur on the site of old large stumps which were dug out, thus working the soil to a considerable depth. The highest plant of 7′ was in such a situation and on the site of the same old stump were three more of over 6′. The average of 4′ 3″ did not, however, take these into account.

(4) The sal in Gorakhpur, to develop best, likes full sunlight and is not tolerant even of side shade. Compare 10 with 13. See also the remarks about the nursery. With a view to test this further, measurements were made along the W. boundary of the nursery. A road runs east and west about midway through the nursery. Forty feet. north of the road on the west boundary a line was taken out at right angles to the line of the tall forest. On this line 20′ out from the edge of the forest the highest and the average of 4 average looking plants was taken along 3′ of an old nursery bed. This was repeated 50′ out and 80′ out. This process was repeated exactly 100′ north of the first line, and exactly 200′ north of it, giving no scope for selection of suitable points. This process was then repeated for 3 more lines just the same way south of the road. There are thus measurements near the old forest, *i e.*, 20′ out, half way out, *i.e.*, 50′ and nearly beyond its influence, *i.e.*, 80′. The sal everywhere was sown at the same time and has since been treated in the same way. There is no difference anywhere as regards former usage of the soil, it was all an old overgrown garden with kokat.

No. of line.	20′ Highest	out. Average.	50′ Highest.	out. Average.	80′ Highest.	out. Average.	REMARKS.
1	2′ 1″	1′ 5″	2′ 11″	2′ 2¾″	5′ 6″	4′ 2½″	For the new nursery as a whole the main crop was taken, not the edges. Highest sapling 9′ 2″, average 5′ 8″ early in July. This has since increased.
2	1′ 7″	1′ 0¾″	2′ 7″	2′ 2″	6′ 9″	5′ 6″	
3	1′ 9″	1′ 4¼″	3′ 2″	1′ 10½″	5′ 9″	4′ 7½″	
4	1′ 8″	1′ 3¾″	2′ 0″	1′ 7¾″	7′ 3″	6′ 1″	
5	1′ 7″	1′ 2″	4′ 1″	2′ 10″	5′ 8″	4′ 10¼″	
6	1′ 9″	1′ 3″	5′ 1″	3′ 6″	6′ 1″	4′ 11¾″	
Total	2′ 1″	1′ 3⅛″	5″ 1″	2′ 4½″	7′ 3″	5′ 0½″	

Thus 50′ from the old forest the sal is nearly twice as high as 20′ from it, and at 80′ out it is twice as high as 50′ out. It does not reach its best until it is about 100′ out.

In conclusion it remains to be said that the present writer has no connection with these experiments except to write about them. During their currency the charge of the division has been held by seven Divisional Forest Officers on eight occasions. The range and the execution of this work has been in charge of Pandit Ram Ratan, a vernacular ranger, with no college training but a great fund of jungle craft. He has carried out the work with the greatest interest and care, and as he has done this for all the experiments detailed, conducting the measurements also himself, it can be said that comparisons may fairly be drawn between the different experiments. It can also be said that the experiments have been carried out under forest conditions when such was intended, though whether it can be said that Range Officers as good and as wise at the work will be found to look after it when it becomes a part of forest routine here is another matter.

B. R. WOOD, I.F.S.,
Deputy Conservator of Forests.

THE SPECIES OF THE GENUS "DIPTEROCARPUS" FOUND IN CHITTAGONG DISTRICT.

BY J. M. AND A. M. COWAN.

The interest in the Chittagong species of the genus Dipterocarpus commonly known as "Garjan" is enhanced by the fact that it was in Tripura adjoining Chittagong that the first species of Dipterocarpus was found.

Dr. Buchanan Hamilton records in the Memoirs of the Wernerian Society, Vol. VI, page 298, that in 1798 he sent to Sir Joseph Banks four specimens of this genus which he then called "Hopea." It was from two of these, probably, that Gærtner took his—the original—figures and descriptions of D. *costatus* and *D. turbinatus*. In 1814 Roxburgh published in Hortus Bengalensis the names of three additional species which he had found in Chittagong, so that by this time seven Chittagong species were known, *viz*., *D. turbinatus* (*Gærtn.*), *D. lævis* (*Ham.*), *D. costatus* (*Gærtn.*), *D. scaber* (*Ham.*), *D. pilosus* (*Roxb.*), *D. turberculatus* (*Roxb.*) and *D. incanus* (*Roxb*).

D. alatus from Chittagong is recorded by Roxburgh in his Flora Indica, published 1832, and our knowledge of the Chittagong "Garjans" has not been added to since.

Herbarium specimens of species of Dipterocarpus are seldom complete. They consist generally of portions of the foliage and fruits picked up from under the lofty trees, and the material from which the original species were made has often been lost. These factors, together with the fact that no field work appears to have been done on the Chittagong "Garjans" since Roxburgh was there about 1814 seem to account for the muddle into which this genus has fallen.

Briefly, *D. turbinatus* (*Gærtn.*) and *D. lævis* (*Ham.*) have been reduced to one species, but there is doubt as to whether this reduction is correct. It is doubtful if *D. turbinatus* (*Gærtn.*) is a Chittagong species. *D. costatus* (*Gærtn.*) has been reduced to *D. alatus* (*Roxb.*).

D. scaber (*Ham.*) has not been recorded since Hamilton found it in 1798. Neither *D. alatus* (*Roxb.*) nor *D. incanus*

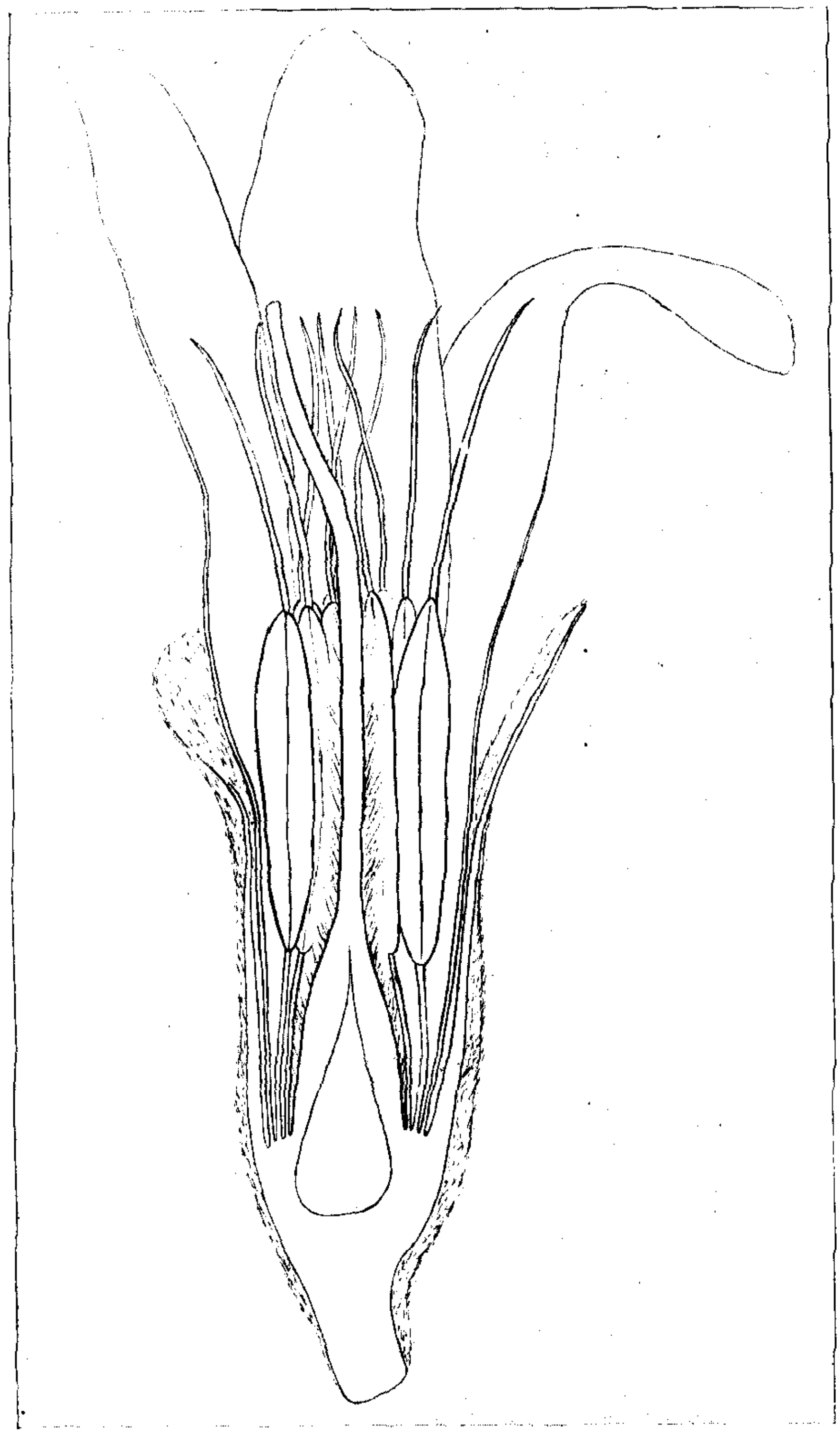


Photo.-Mech. Dept., Thomason College, Roorkee.

Dipterocarpus costatus, Gaertn.
Vertical section of flower × 15.

(*Roxb.*) have been found since Roxburgh recorded them in 1814 and Chittagong has been regarded as probably beyond their area of distribution.

Recently with the help of the Range Officers in Chittagong, Chittagong Hill Tracts and Cox's Bazar Divisions, we have been able to collect a large number of specimens and have seen all the material in the herbarium at the Royal Botanical Gardens, Sibpur.

It should be noted that beyond the generic name "Garjan," no importance can be placed upon the Chittagonian names for distinguishing species, the same tree for example being known by different individuals as "Dulia" or "Telia."

The Chittagong "Garjans" may be classified as follows:—

(A) Calyx tube without ribs or wings.

(1) *D. turbinatus.* Gærtn. f. Fruct. iii, 51 t 188; Roxb. Hort. Beng. 42 et. Flor. Ind. 612; et Incones. ii; Ham. in Mem. Wern. Soc. VI. 300; Wal. Cat. 952; A. D. Condolle, Prod. XVI. ii. 607; W. and A. Prod. 85; Dyer in Hook, Fl. Br. Ind. I. 295; Journ. Bot. 1874, 102, 143, fig. 13; Kurz. For. Fl. Bur. i, 114; King. Jour. As. Soc. ii. 92; Watt. D.E.P. 701; Gam. Timbers 32; *Prain. B. P. i 252; Br.* Journ. Linn. Soc. XXXI, 27. *D. lævis.* Ham. l. c. 299; Roxb. Pl. Corom. 3 t 213; A. D. C. l. c. 607; W. and A. l. c. 85; Kurz. l. c. 114; Pr. l. c. 252; Br. l. c. 27.

We follow the Index Kewensis in reducing *D. lævis (Ham.)* to *D. turbinatus (Gærtn.).* The Chittagong material collected by us agrees with the *D. turbinatus* of Roxburgh of which there is an original specimen in the Calcutta herbarium. These, however, differ from Gærtner's figure by having the nut more pointed at the base. The characters on which these two species have been separated, *viz.*, young branches compressed or not, and the difference of pubescence on the under surface of the leaf vary in individuals, and do not seem distinctive enough to separate the species. Further field work however is required.

Distribution.—Throughout Chittagong, Chittagong Hill Tracts, Burma, Assam (Surma Valley), and doubtfully South India. "Telia" or "Dulia garjan" in Chittagong.

(2) *D. pilosus.* Roxb. Hort. Beng. 93, et Fl. Ind. ii, 615; Dyer in Hook, Fl. Br. Ind. I. 296; Kurz. Flor. Fl. Burm. i, 115; D. *baudii.* Korth. verh. Nat. Gesch. Bot. 59, t 5; Pr. B. P. i, 252; Watt. D. E. P. 692. Br. Journ. Linn. Soc. XXXI, 27.

First found by Roxburgh on Moiskhal Island.

Found by us on Moiskhal Island and in Ramghar-Sitakund Range.

In the juvenile the leaves are about twice as big as in the adult stage and both leaves and stems of the juvenile form are densely covered with tufts of yellow hairs.

We have not seen flowers or fruits.

Distribution.—Chittagong, Chittagong Hill Tracts (King's Collector), Burma and Assam (Brahmaputra Valley). "Garjan" or "Arjan" in Chittagong.

(B) Calyx tube with angles projecting on the upper part only.

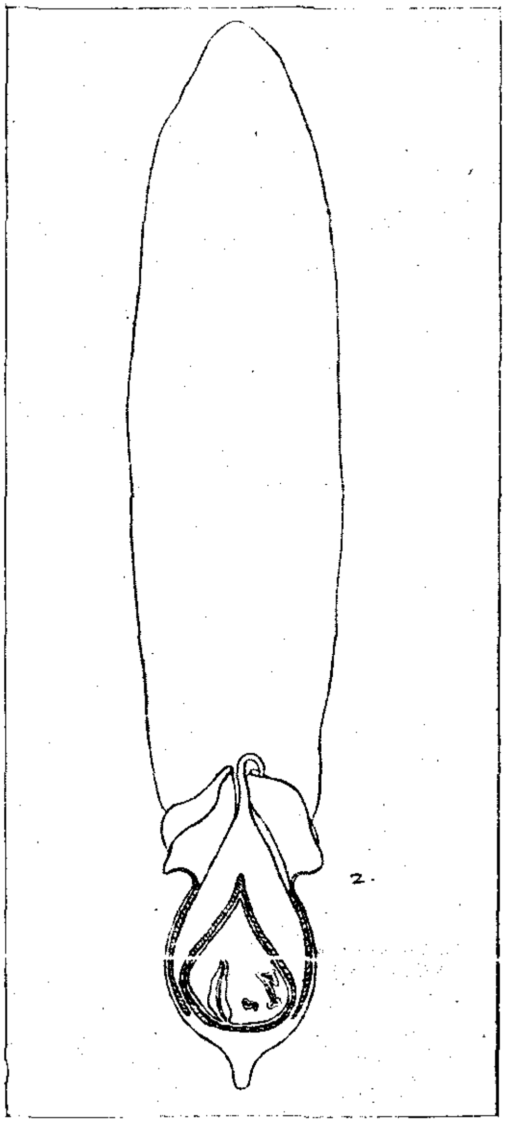
(1) *D. tuberculatus.* Roxb. Hort. Beng. 93; et Flor. Ind. 614, et Icones ii; Dyer in Hook. Fl. Br. Ind. I 297; Kurz. For. Fl. Bur. i, 113; Pierre Fl. For. Cochin. Faso. 14 t 218; Watt. D. E. P. 696; Br. Journ. Linn. Soc. XXXI, 32; Pr. B. P. i, 252.

Recorded by Roxburgh in 1814 from Chittagong. There are no specimens in the Calcutta herbarium from Chittagong nor have we found any.

(C) Calyx tube with five ribs.

(1) *D. costatus.* Gærtn. f. Fruct iii, 50. t 137; Ham. in Mem. Wern. Soc. VI, 299; Kurz. Flor. Br. Ind. i, 117; King Journ. As. Soc. Bengal, 99; Br. Journ. Linn. Soc. XXXI, 35; Pr. B. P. i, 252.

Gærtner named this plant probably from material sent him by Hamilton who first discovered the tree in Tripura. Gærtner has left a figure and description of the fruit only.



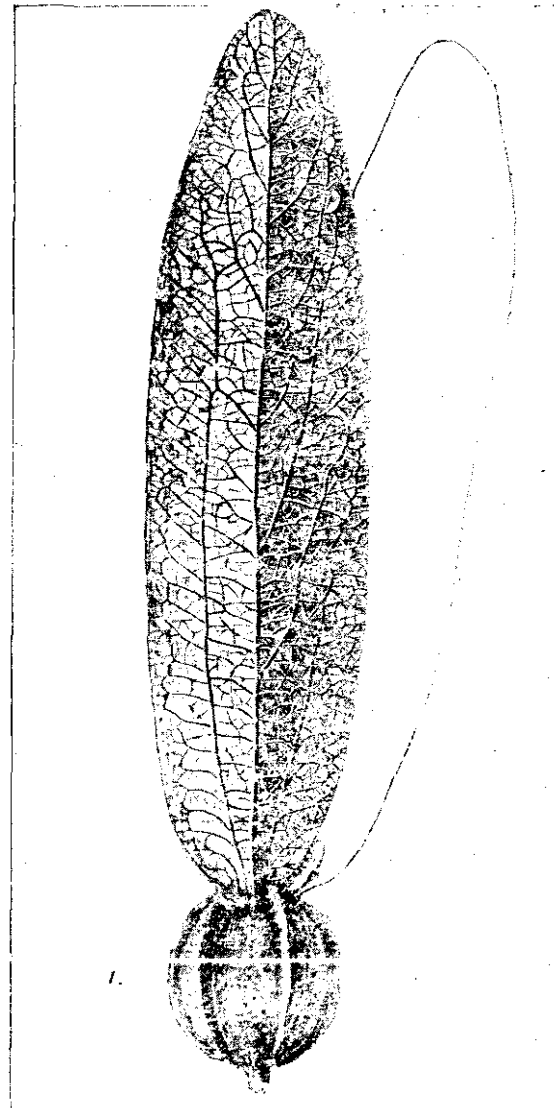


Photo.-Mech. Dept., Thomason College, Roorkee.

Dipterocarpus costatus, Gaertn.

1. Mature fruit × 2.
2. Section of same × 2.

Hamilton's description is very brief. Dyer in Hooker's Flora of British India has reduced this species to *D. alatus* (Roxb.) considering Gærtner's drawing to be an inaccurate figure of a five winged species. More recently a species with a ribbed calyx tube was found in Burma by Kurz. No flowers have been found.

The Index Kewensis follows Dyer in reducing *D. costatus (Gærtn.)* to *D. alatus (Roxb.)*.

Following Dyer's reduction a great deal of confusion has arisen in the descriptions of these species. It is now evident from complete material which we have collected from Chittagong, that Gærtner's drawing is an exact representation of the mature fruit of this "Garjan" and that Dyer was altogether wrong in making the reduction.

D. costatus is therefore a good species. As complete materials have hitherto not been collected, a description and figures are appended.

Distribution.—Jaldi and Garjania Ranges Chittagong, Tripura and Burma.

Sada—, telia—, dulia—, guti—, chikunia—, kashia Garjan in Chittagong.

(2) *D. scaber.* Ham. in Mem. Wern. Soc. VI, 300; Dyer Hook. Fl. Br. Ind. I, 297; Br. Journ. Linn. Soc. XXXI, 35.

We suggest with Prain that *D. scaber (Ham.)* is probably only a form of *D. costatus (Gærtn.)*.

Immature shoots and fruits of *D. costatus* collected by us agree with Hamilton's descriptions of *D. scaber*.

Hamilton's specimen of *D. scaber* in the Banksian herbarium we have not been able to consult, and there are no specimens in the Calcutta herbarium.

We suspect that these two species bear very much the same relation as *D. turbinatus (Roxb.)* and *D. lævis (Ham.)*. *D. costatus* being the older name should be the name of the species. A comparison of our immature material with Hamilton's specimen in the British Museum may definitely decide this point.

(D) Calyx tube with five wings.

(1) *D. alatus.* Roxb. Hort. Bengalensis 42, et Icones ii; Wall. Cat. 953; A. D. Condolle. Prod. XVI. ii, 611; Dyer in Hook. Fl. Br. Ind. I, 298; Journ Bot. 1874, p. 106; Kurz. For. Fl. Burm. i, 116; Pierre For. Fl. Cochinch. t 212; Oleoxylum balsamiferum Wall. Cat. 157; Heim. Researche sur les D. t, Br. Journ. Linn. Soc. XXXI, 34.

(2) *D. incanus.* Roxb. Hort. Beng. 42, et Fl. Ind. ii. 614; Wight Prod. 84; A.D.C. XVI. ii, 611; Dyer in Hook. Fl. Br. Ind. I, 298; Journ. Bot. 1874, 106; Kurz. Journ. As. Soc. Beng. XLIII. ii, 98, et Fr. Fl. Burm. i, 113; King Journ. As. Soc. Beng. LXII. ii, 97; Br. Journ. Linn. Soc. XXXI, 35.

D. alatus (*Roxb.*) and *D. incanus* (*Roxb.*).

In the Hortus Bengalensis, published 1814, *D. alatus* (*Roxb.*) is recorded from Pegu and *D. incanus* (*Roxb.*) from Chittagong in 1810. Roxburgh's Flora Indica (1832) describes *D. incanus* (*Roxb.*) from Chittagong and *D alatus* (*Roxb.*) from Moiskhal, the only distinction between the two being that *D. incanus* (*Roxb.*) has leaves ovate with base somewhat tapering, while *D. alatus* has ovate-oblong to ovate-cordate leaves. There is a drawing by Roxburgh of *D. alatus* in the Royal Botanical Gardens, Calcutta, but he has left no drawing of *D. incanus* nor specimens.

Hooker's Flora of British India (1872) retains *D. alatus* (*Roxb.*) and *D. incanus* (*Roxb.*), both having leaves ovate, distinguishing *D. incanus* (*Roxb.*) by its having leaves thinly pubescent on both surfaces, lateral nerves 12, petiole 2″; while *D. alatus* (*Roxb.*) has leaves shining above, lateral nerves 15, petiole 1½″. A. DeCondolle follows Roxburgh's description. Kurz describes *D. alatus* (*Roxb.*) from Pegu to Arakan as having ovate to ovate-oblong leaves obtuse at the base, which agrees with Roxburgh's *D. incanus*. Kurz does not describe *D. alatus* (*Roxb.*). King regards the leaves of *D. incanus* (*Roxb.*) as broadly ovate, base rounded or sub-cordate, those of *D. alatus* (*Roxb.*) as ovate elliptic with cuneate base, exactly reversing Roxburgh's original description. He adds

that the calyx tubes of *D. incanus* are 1·5″ broad while those of *D. alatus* are 0·5″ broad.

In the material at the Calcutta herbarium these characteristics overlap. Some specimens with cuneate leaves have a broad calyx wing, some a narrow, and *vice versâ.*

The characters on which the two species are based appear to us to be too indefinite. Whether one takes the shape or size of the leaf, the number of veins, pubescence, the shape of the buds, or the width of the calyx wings, the variation between individuals and in the same individual at different ages is so great, that we cannot find any constant character.

There is, however, a five winged species in Chittagong.

Distribution.—Chittagong in Rezu Range, south of Jaliapalong. There are three large trees in the Collector's garden.

Burma, Andamans.

"Garjan" or "Harra Garjan" in Chittagong.

Dipterocarpus costatus, Gærtn.

Ramuli teretes, majores pubescentes, juniores villosissimi, cicatribus stipularum annulati.

Folia alterna, ovata vel elliptico-ovata, acuta, repanda, majora supra fere nuda, subtus pubescenta, juniora utrinque pilis fasciculatis instructa, margine ciliata, 4—6 poll. longa, 2—4 poll. lata, venis subtus prominentibus.

Petiolus ad apicem incrassatus, barbatus, 1 poll. longus.

Racemi axillares, 3—6 flori.

Calyx 5-fidus, tubo infundibuliforme, parum costato, barbato, lobis inaequalibus utrinque pilis instructis.

Petala 5, basi paulo coherentia, lobis calycis alterna, aestivatione in eodem ramo alternatim dextrorsum et sinistrorsum contorta, purpurea, mollibus pilis praesertim subtus villosa.

Stamina numerosa, filamenta breviora, anthera basifixa, longa, lineara, sagittata, connectivo ultra loculos in apiculum producto.

Ovarium, toro semi-immersum, barbatum. Stylus barbatus. Stigma acutiusculum. Endospermum ruminatum.

THE MENSURATION OF PLANTATIONS.

The number of plants required to completely stock a plantation by regular planting in equilateral triangles has been calculated on pages 181, 182 of Schlich's Manual of Forestry, Vol. II, and also on pages 78, 79 of Troup's Manual of Forest Mensuration.

The calculation in both cases appears to be incorrect, the correct calculation being as follows :—

I. There are three cases to consider where, as in fig. 47depicted on page 79 of Troup's Manual, the length of the rows is an exact multiple of the distance between the plants, *i.e.*—

(i) Where the number of rows is an even number,

$$\text{then } N = \tfrac{1}{2}(m+1)(n+1) + \tfrac{1}{2}(m+1)\,n.$$
$$= \tfrac{1}{2}(m+1)(2n+1)$$
$$= mn + \frac{m}{2} + n + \tfrac{1}{2}$$

where L = length of area at right angles to the rows
B = breath of area parallel to the rows
d = distance between the plants,

$$m = \frac{L}{d \times {\cdot}866}$$
$$n = \frac{B}{d}.$$

(ii) Where the number of rows is an odd number and the side rows terminate in plants,

$$\text{then } N = [\tfrac{1}{2}(m+1) + \tfrac{1}{2}](n+1) + [\tfrac{1}{2}(m+1) - \tfrac{1}{2}]\,n$$
$$= \tfrac{1}{2}(m+2)(n+1) + \tfrac{1}{2}mn$$
$$= mn + \frac{m}{2} + n + 1.$$

(iii) Where there are an odd number of rows and the side rows do not terminate in plants

$$\text{then } N = [\tfrac{1}{2}(m+1) - \tfrac{1}{2}](n+1) + [\tfrac{1}{2}(m+1) + \tfrac{1}{2}]\,n$$
$$= \tfrac{1}{2}m(n+1) + \frac{n}{2}(m+2)$$
$$= mn + \frac{m}{2} + n.$$

II. There is only one case to consider where, as in fig. 48 on page 79 of Troup's Manual, the length of the rows is not an exact multiple of the distance between the plants—

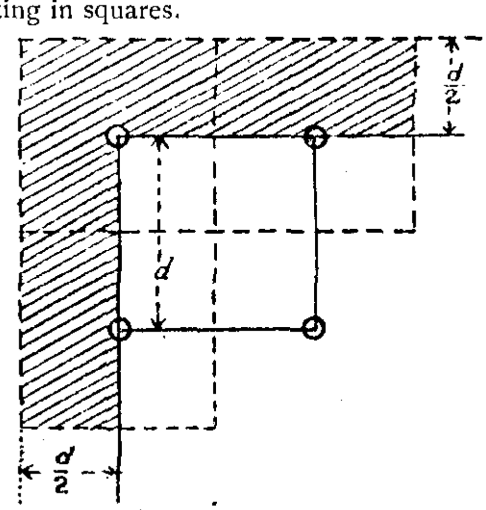
$$\text{then } N = (n+\tfrac{1}{2})(m+1)$$
$$= mn + \frac{m}{2} + n + \tfrac{1}{2}.$$

Now the above formulæ, as well as others given in the Manuals quoted above for the number of plants in line, square, and quincunx

formations are both interesting and useful; but obviously these formulæ do not allow for the fact that the trees along the edge of the area spread outwards as well as inwards. Provided the general formulæ are used, and provided it is of no consequence to what extent the crowns of the trees along the edge of the plantation spread outwards, the results obtained would be sufficiently accurate. But if the owner of the plantation does not wish the crowns of the trees to overshadow adjoining lands, or if instead of using the general formulæ the special formulæ for the number of plants per acre are used, then the results obtained will not be accurate, and if the formulæ for the number of plants per acre be used for large areas the error will increase in proportion to the acreage.

It is, therefore, very necessary to have a set of formulæ which will give the number of plants on an acre of ground *including* the strip round the edge over which the crowns of the trees will sooner or later extend. These formulæ are actually given in both Manuals, but as they are only referred to as suitable for obtaining approximately accurate results for the cases where the outer strip round the edge is neglected, and since it seems probable that their authors did not realise the full significance of these approximate formulæ, they will be briefly worked out with explanatory diagrams below :—

(i) Planting in squares.



(*Note.*—In this and succeeding figures the shaded portion represents part of the outside edge round the unit acre area as seen at a corner of this area.)

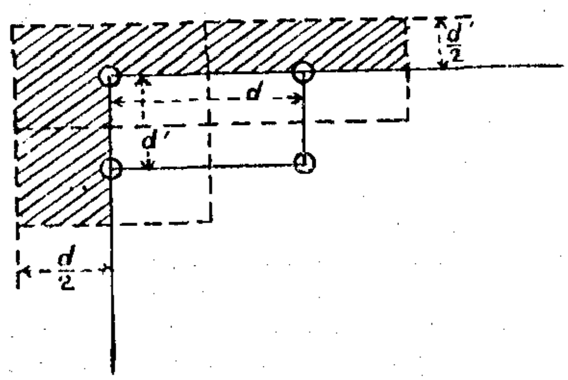
New—area of square occupied by a single plant $= d^2$

If N = number of plants per acre

then $Nd^2 = 43560$

and $N = \frac{43560}{d^2}$

(ii) Planting in lines.

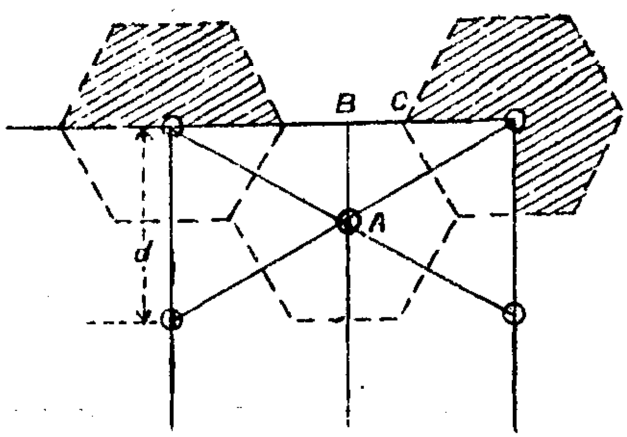


Area of rectangle occupied by a single plant $= dd'$.

So that $Ndd' = 43560$

and $N = \frac{43560}{dd'}$.

(iii) Planting in equilateral triangles.



Area of $\triangle$ ABC $= \frac{AB\ BC}{2}$

$= \frac{d_2}{8}$ Tan 30°

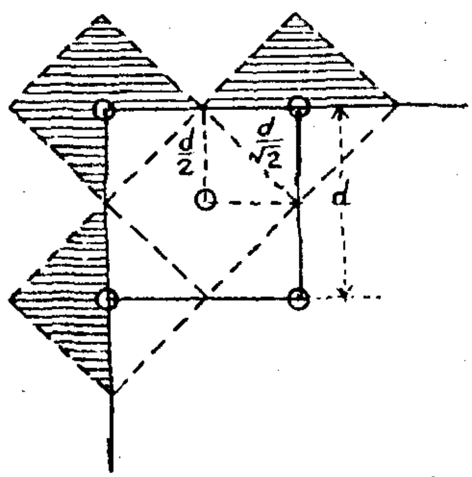
$\therefore$ Area of hexagon occupied by a single plant $= \frac{3d^2}{2}$ Tan 30

$= .866d^2$

$\therefore$ $N \times .866d_2{}^1 = 43560$

$\therefore$ $N = \frac{43560}{.866d^2}$

(iv) Planting in quincunxes.



Area of square occupied by a single plant $= (\frac{d}{\sqrt{2}})^2 = \frac{d^2}{2}$

$\therefore$ $N \times \frac{d^2}{2} = 43560.$

$\therefore$ $N = \frac{87120}{d^2}.$

Finally it may be interesting to compare the number of plants per acre according to the above formulæ where the plants are at an average distance apart of say ten feet. In the case of lines the number of plants will always be greater than in the case of squares and will increase proportionately as the difference between d and d^1 increases. This proportion is however limited in practice by the necessity for giving the plants space to develop in all directions to a reasonable extent without forcing the crown to assume any very abnormal shape. It seems reasonable to limit the disproportion between d and d^1 to the point where $d = 2d^1$. Then $\frac{3}{4}d = 10$. So that $d^1 = 6\frac{2}{3}$ and $d = 13\frac{1}{3}$,

And the number of plants per acre is—

By squares or quincunxes	436.
By lines	490.
By equilateral triangles	503.

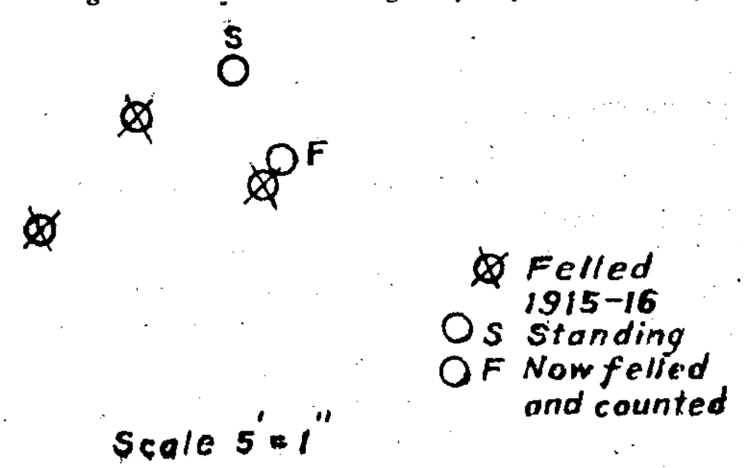
A. E. OSMASTON, I.F.S.

THINNING OF DEODAR.

I have more than once seen the doubt expressed as to whether conifers which have been left unthinned to a comparatively advanced age can be made to improve their rate of growth by means of heavy thinning.

In Nalderah Forest of Koti State, a Deodar crop of very great density was thinned heavily in 1915-16, and under the existing 5 years' thinning scheme was thinned again this year. On a rough estimate, the dense forest covered an area of about 300 acres and about from 25 to 30 trees were removed per acre in the first operation. In the felling now in progress, the number of trees per acre is about one-fifth of the previous number.

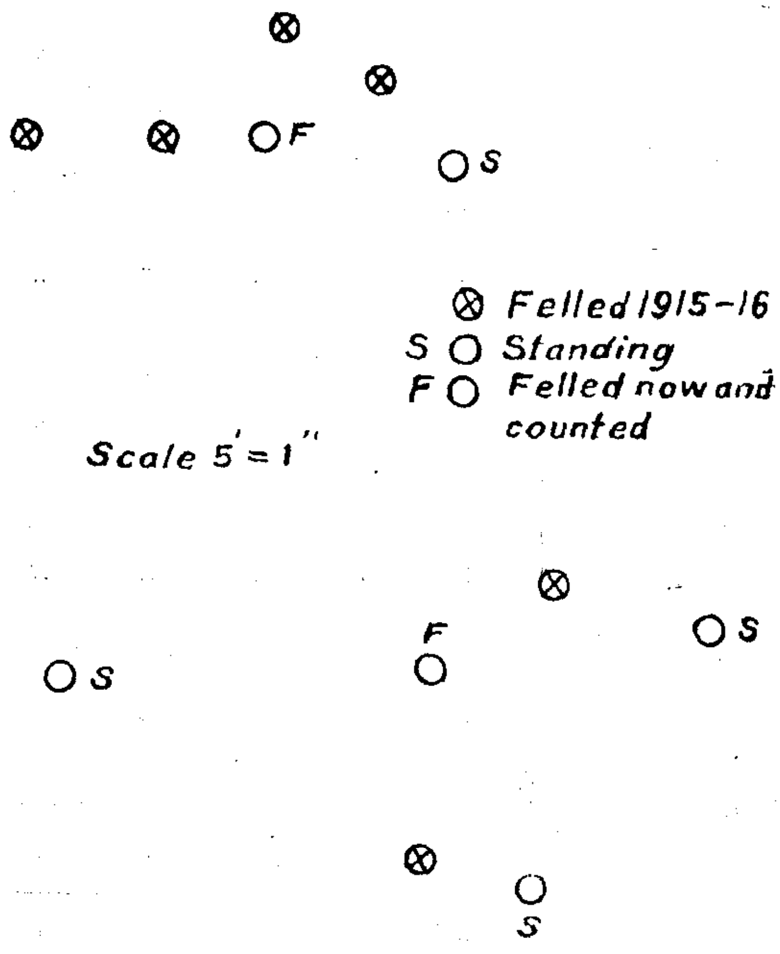
The stumps of three trees from this year's thinning were counted last month, *viz.*, Nos. 3 to 5 of the attached statement. Nos. 1 and 2 were trees left standing which were felled specially for counting, with the trees show a greatly improved rate of growth,



as compared with the average for the whole life period and that of the previous few years. In the case of No. 2, the rate has almost trebled.

The diagrams show how dense the forest was before the first thinning.

A. H. WALKER, I. F.S.



Serial No.	Girth at breast height: Feet.	Girth at breast height: Inches.	Length of radius in inches.	Total age.	Length of radius occupied by last 5 rings.	No. of rings in previous half inch.	Rate of growth in rings per inch: Whole Stumps.	Rate of growth in rings per inch: Last 5 rings.	Rate of growth in rings per inch: Previous half inch.	Age from Kulu yield table.
1	1	9½	3·6	71	0·5	10	20	10	20	28
2	1	11	3·8	75	0·6	13	20	8·3	26	30
3	2	6	4·5	71	0·4	12	16	12·5	24	38
4	2	9	6·0	86	0·4	11	14·3	12·5	22	42
5	2	9	6·0	87	0·4	10	14·5	12·5	20	42

THE FORESTS OF INDIA AND THE DEVELOPMENT OF THE INDIAN FOREST DEPARTMENT.

Paper read by Professor E. P. Stebbing, M.A., before the British Association for the advancement of Science at the Meeting in Edinburgh held between September 7th—14th, 1921.

Some two centuries and more ago a Forest Policy existed in Britain, broadly based on the requirements, in oak chiefly, of the Navy and Mercantile Marine. For two centuries or so the various Governments of the day in terested themselves in forestry matters owing to the neces. sity of having home grown timber in sufficient quantities for the construction of vessels. A Forest Policy, even though it had only one main object in view, existed. It had all but disappeared towards the end of the 18th century and came to an end early in the 19th century. The change of materials in the construction of ships, the extraordinary rapid extension of intercommunication between the Nations brought about by the introduction of steam and the consequent facility with which imports of timber reached these islands upon which all duties had been removed accounted for the ignorance of all appertaining to scientific forestry as understood on the continent of Europe which prevailed throughout the 19th century. In the latter half of that century the beginnings of a Forest Policy and the growth of a scientific administration of the forests in our greatest Dependency at that time, India, began to make their appearance.

It may cause some surprise when it is stated that the diminution towards the end of the 18th century and the commencement of the 19th century of the supplies of oak timber in this country, required for maintaining the Navy, had a considerable bearing on this later development of a Forest Policy in India. But the contention can be substantiated.

During the Naval warfare which occurred throughout the period above alluded to the supplies of oak timber in Britain became greatly reduced. The necessity of finding a timber to replace the failing oak supplies was imperative and the Admiralty, after instituting searching enquiries in Africa and elsewhere, enlisted the aid of the East India Company. A substitute was found in the Indian teak forests. Teak timber was first exported from Bombay from the western forests of

Malabar and Kanara. The Arabs who had held command of the sea in these parts had for long procured their teak from these forests. During the first quarter of last century heavy fellings were carried out in the Malabar and Kanara forests. At the end of this period the accessible supplies from this region gave out and recourse was made to the forests of Tenasserim and Marteban after the annexation of the southern part of Burma in 1826. These forests were as ruthlessly exploited as had been the case in Bombay and Madras.

The growth of a Forest Policy in India was slow. There were many mitigating factors at first. Those responsible for the management of affairs had no difficulty in procuring all their requirements from the forests. The great continent appeared to hold inexhaustible tracts covered with dense jungles. Their contents were unknown nor was there any apparent necessity for their detailed exploration even had this been a possibility. The process of building up the Empire province by province in itself covered a considerable period of years. Amongst the Empire Officials scientific knowledge was confined almost entirely to the members of the medical profession and had this not been the case, in the early years of our occupation, the botany of the forests, the species of trees they contained, and their respective value was an unopened book. The fact also that great tracts of the jungles were the aftermath of the method of shifting cultivation, which had been practised for centuries, and contained nothing but a worthless scrub was a matter which received slow recognition. The only knowledge of the great forests in the North of the country was confined to scattered references in the journals of such early explorers as Cunningham, Royle, Wallich, Jacquemont and others.

To the Governors of the country the important part which forests play in nature and the great influence they exercise on the physical well being of a country was unrecognised; nor were they able to appreciate their importance to the people or their revenue producing capacity. The Government for some years obtained their requirements without difficulty and the people took all they wanted. The early administrators appear to have been convinced that this state of affairs could go on for an unlimited period; and that in many localities forests were an obstruction to agriculture and therefore a limiting factor to the prosperity of the Empire. The whole policy was to extend agriculture and the watchword of the time was to destroy the forests with this end in view. The direct

and indirect value of the forests was underestimated as is clearly exhibited by the provisions of many of the earlier settlements, especially in Bengal and the Punjab, which transferred large forest areas in perpetuity to landowners or to cultivators who at that period had no legal right to them nor did they at the time appreciate the boon conferred; for they attached no greater value to the areas than the Government itself. In other cases, and they were numerous, where the forests were not entirely alienated, *the main rights of users, which constitute the value of* the possession of the forests, were abandoned in favour of the cultivator.

This as will be shown was a transitory period, but enormous destruction to valuable forests was the outcome during the period, and the time arrived when with the advance of modern civilisation and the increased demands of both population and trade the diminution of the forests began to be regarded with grave apprehension. The spread of Railways at a later period brought the matter to a head. But before their appearance the increased area under agriculture and the rapidly multiplying flocks and herds, which ensued owing to the greater security afforded the people under the settled Government of British rule, caused greater demands upon the forests and their produce. And to obtain these demands the same methods continued to be practised, the habits of a pastoral and semi-nomadic population. No check had yet been introduced into the practice of firing the forests annually in spite of the *glaring anomaly* that if young growth was burnt annually it was obvious there could be no old trees for a future generation. The true state of affairs was not appreciated by the Government until the failure to supply local requirements began to be felt. The first of these requirements which began to give out comparatively early was timber for ship building; but in most instances the solution of the difficulties encountered was sought for in improved methods of exploitation both by Government agency or through contractors, and even when protection was accorded *this was, for many years, only given to certain species of trees and not to* the forests as a whole. The Keynote then of our interest in the Indian Forests between the years 1796 and 1860 may be said to have been their exploitation for timber—chiefly teak, in the Madras and Bombay Presidencies, in Burma and Central India; Deodar in the N.-W. Himalayas and Sal in the United Provinces, extending eastwards to Assam, in a lesser degree. For the rest the natives of the country were allowed to continue in their old way and unchecked felling, burning and grazing

was rife in all the forest areas accessible to the population. Early in the period such large centres as Calcutta were importing their timber requirements from distant forests in the North whilst Southern India was indenting on the Ceylon forests. The one valuable piece of work undertaken during this period was the commencement of the now well-known and valuable Nilambur Teak plantations. Their inception was due to Mr. Conolly, Collector of Malabar. He had become convinced that the only hope of replacing the destroyed teak forests was by forming teak plantations and he initiated in 1844 a piece of work with which his name will be always connected. At first considerable difficulty was experienced in getting the teak seed to germinate. This trouble being overcome the plantations were commenced and have never again looked back. Considerable areas of very valuable teak forests are now reaching maturity, it having been calculated that the thinnings therefrom have paid all the expenses incurred to date. Mr. Conolly was barbarously murdered in 1867 by the Moplahs in the verandah of his bungalow. The new Forest bungalow erected in the site of Mr. Conolly's has recently been burnt down in the present rising of the Moplahs and the Forest Officer, M. C. Chandy, an Indian, who received his forestry training here in Edinburgh, graduating in 1914, sought safety in flight.

The annexation of Burma was to some extent an outcome of the valuable teak forests the country contained. The first portions of the country to come under British rule in 1826 were the Southern Provinces of Tenasserim and Marteban. This annexation, which closed the first Burmese War, was primarily due to the necessity of safeguarding our south-eastern frontier which the chaotic conditions engendered by the misrule of the Burmese Government rendered otherwise untenable. The exploitation of fine teak forests was carried out on a large scale during the next quarter of a century. Soon after the annexation Dr. Wallich, Superintendent of the Botanical Garden, Calcutta, was deputed to visit the Teak forests and report on their value. He was greatly impressed with their potential value and in his valuable report, 1827, strongly recommended that they should be kept in Government hands and worked by Government and not be given out to private timber merchants to be cut out and destroyed as had been the case in Malabar. His advice was not taken. The unfortunate license system was introduced, by which timber merchants were allowed to take up leases of the teak forests and hack and cat at pleasure. By the middle of the century the fine forests

of this region had been practically cut out. Moulmein, it is true as a result, had grown into a flourishing port, but the whole of the energies of the commercial community had been devoted to this one article of commerce to the detriment of the development of the country in other directions.

The outcome of the second Burmese War was the annexation in 1852 of the Pegu Province with Rangoon as the capital. The northern portion of the new Province as delineated at the time was thought to take in all the best teak forests. This was subsequently found to be incorrect, some of the most valuable forests lying outside this northern line. Under the management of the late Sir D. Brandis the Pegu forests were placed under a better organisation than had been the case with those in the south. The third Burmese War which led to the annexation of Upper Burma in 1885 and the disappearance of the Burmese dynasty was a direct outcome of a dispute between a big British Timber Corporation and the Burmese Government which eventually necessitated the intervention of the British Government with war as a result. By that time the Native Government of Upper Burma existed in little more than name. Acts of the most tyrannical despotism were carried out in the name of the King all over the country : whole countrysides were depopulated and intervention by the British sooner or later was a foregone necessity. But the actual *cassus belli* was over the teak timber which formed one of the chief articles of commerce of the country. The same efforts were made by the great timber corporations to secure the exploitation of these valuable forests under the lease system, efforts which fortunately were defeated by Mr. Ribbentrop, at the time Inspector-General of Forests.

The day of the ruthless exploitation of the Indian forests had gone by. Lasting through half a century of ignorance its sun had set with the arrival of the first trained Forest Officer in the country in 1856 in Mr. Brandis. But the first beginnings of real forest administration had set in before that arrival. The Government had become alarmed at the decrease in timber supplies and Conservators of Forests were appointed in Bombay and Madras. Dr. Gibson in Bombay in 1847, Dr. Cleghorn in Madras in 1856, and Dr. McClelland in Pegu in 1853.

In a Resolution issued by the Government of India in 1865 Dr. Cleghorn was justly designated as the Father of Indian Forestry and

the British Association may justly claim to have had perhaps some share in the introduction of Forestry Conservation in India. The history of this period may be briefly glanced at. In 1847 Dr. Cleghorn was a young Civil Surgeon in Shimoga in Mysore. Being interested in botany his attention was gradually drawn to the great destruction of the forests taking place in Mysore due to the practice by the people of the method of shifting cultivation. Under this pernicious method an area of primeval forest is selected by the cultivator, all the trees are felled, the branches cut off and piled up to dry in the hot sun and then fire is applied and the mass burnt to ashes. The ashes are then raked roughly over the area, a coarse grain sown before the monsoon breaks and the cultivator then sits down and waits till the crop is ripe when he reaps it. The following year a second crop may be taken off the area. By the third year a dense growth of weeds and soft wood saplings will cover the area and it is vacated and a fresh piece of virgin forest selected for operations. After inspecting considerable areas on the countryside which had been treated in this fashion by generations of the people Cleghorn wrote a report on the subject which was commented upon by the Commissioner in a letter to the Government in May 1847. Cleghorn then came home on furlough and at the meeting of the British Association in Edinburgh in 1850 drew the attention of the Association to the great destruction which was taking place in the Tropical Forests of the Empire which were at the time without any systematic conservation. The British Association asked that a Report on the subject should be drawn up and presented to the next Meeting. A Committee was appointed consisting of Dr. Hugh Cleghorn, Madras Medical Establishment; Professor Forbes Royle, King's College, London, who had travelled and worked in India; Captain R. Baird Smith, Bengal Engineers and Captain R. Strachey, Bengal Engineers. The Report was entitled, "Report of the Committee appointed by the British Association to consider the probable effects in an Economical and Physical point of view of the Destruction of Tropical Forests." Since the four members of this Committee were chiefly acquainted with Indian conditions the Report confined itself to a review of the position of the forests in India at the time and laid down the principle that wherever the land then under forest was not required for the extension of agriculture the forests should be preserved in the interests of the country, the climate and the maintenance of the water supplies in the rivers, streams and springs. In 1847 the Court of

Directors at home had addressed a Despatch to the Supreme Government in India requesting the attention of the Authorities to the effect of trees on the climate and productiveness of a country or district. The Report of the British Association Committee quotes numerous instances recorded in answer to this Despatch chiefly from Madras and Bombay of the ill-effects which the devastation of the forests had had in India and the authors summed up their conclusions as follows :—

1. That over large portions of the Indian Empire there is at present an almost uncontrolled destruction of the indigenous forests in progress from the careless habits of the native population.

2. That in Malabar, Tenasserim and Sind, where supervision is exercised, considerable improvement has taken place.

3. That these improvements may be extended by a rigid enforcement of the present regulations and the enactment of additional provisions of the following character, (*viz.*) careful maintenance of the forests by the plantation of seedlings in place of mature trees removed, nurseries being established in the immediate neighbourhood, prohibition of cutting until trees are well-grown, with rare exceptions, etc.

4. That special attention should be given to the preservation and maintenance of the forests occupying tracts unsuited for culture whether by reason of altitude or peculiarities of physical structure.

5. That in a country to which the maintenance of its water supplies is of such extreme importance the indiscriminate clearance of forests around the localities wherever these supplies are derived is greatly to be deprecated.

6. That as much local ignorance prevails as to the numbers and nature of valuable forest products, measures should be taken to supply, through the officers in charge, information calculated to diminish such ignorance.

The years following the publication of this report witnessed the commencement of forest conservancy in India. Cleghorn was appointed Conservator in Madras in 1856. His investigations into the timber and fuel question in the different parts of the Presidency resulted in a department being built up, the forests of the several districts being placed under forest officers. Although timber supplies were of primary importance for military and public works requirements the question of the supplies of fuel received serious attention during these years. In large cities like Madras and Calcutta this matter was causing anxiety and a

similar state of affairs existed in the Hill Stations such as Ootacamund in Madras and Simla, Mussoorie and Darjeeling and other stations in the Western and Eastern Himalayas. In the plains of Northern India, the North-West Provinces and the Punjab, the question of fuel reserves and their reservation and protection and maintenance was a matter which was calling for careful consideration since the advent of the railway, which burnt wood fuel only, had enormously increased the demands for fuel from the several forests which previously had only to supply the flotilla of steamers on the Indus running down to Karachi and back.

During the decade following the publication of the British Association Report a notable change came over the administration of the Indian Forests and that the new views had come into being may be attributed to the work and exhortations of such men as Wallich, Falconer, Gibson, Cleghorn and McClelland. It was as the direct outcome of a valuable report by McClelland in 1854 on the Pegu Forests that Lord Dalhousie wrote his celebrated Minute of August 3rd, 1855, which may be termed the "Forest Charter" of India. In this Minute for the first time a definite forest policy was enunciated for the management of the forests of India in order to conserve them, so far as possible, in perpetuity, in the interests of the people and the public service and to prevent those that were still left being cut out in those of timber capitalists. And the Scotsman found a German, Brandis, to give effect to his policy.

As has been said on taking over charge of the Burma Forests Brandis' first object was to put an end to the system of leasing out the forests to timber merchants. He had a stiff fight but with Government support the large vested interests of these people were brought under a regimé which ensured the conservation, in the interests of the community, of those forests which yet remained undestroyed; and this policy was continued by Mr. Ribbentrop at a later date in the forests of Upper Burma.

In 1862 Brandis was transferred to India and in conjunction with Cleghorn drew up the lines of a definite forestry administration for India as a whole. Brandis was appointed Inspector-General of Forests in 1864. Brandis' transfer to the headquarters of the Government of India was the first step taken by the Governor-General Lord Minto after a full consideration of the Forestry position in the parts of India directly administered by the supreme Government outside Madras and Bombay who had local Governors appointed from home. The Secretary of State for India had

in several despatches exhibited considerable anxiety on the question of the protection and conservation and improvement of the forests, it having been at last realised that the blunders and inattention of the past sixty years had brought the country to a serious position as regards the supplies of timber required for the Public Works, Railways and so forth, whilst in many parts the people were suffering owing to the scarcity and dearness of fuel and small timber supplies. The Despatch of the Governor-General reviewed the whole position and stated that it was proposed to form local forestry departments in each province consisting of Assistant Conservators with a Conservator in charge of the provinces and a subordinate staff of foresters and forest guards. He proposed that an officer should be appointed as an Inspector-General of Forests or Controller of Forests to advise the Government of India on technical and administrations questions.

The Secretary of State in replying to this Despatch accorded his hearty approval to the proposals and trusted that early steps might be taken to introduce conservancy and protection into the remaining backward provinces amongst which were the North-West Provinces, Bengal, Assam and the Central Provinces.

It will not be possible to do more than indicate here the growth of the new Forest Department in India. Its introduction came none too soon.

No check to the ruthless exploitation of the great forests of Bengal or Upper India had been instituted during the 60 years I have dealt with. And the incidence of the Mutiny led to an enhanced destruction which spread to the less populated forest districts of Central India, in order to provide sleepers for the railways which it had become manifest must be constructed. The position when Brandis became the first Inspector-General was, briefly as follows :—

Enormous areas of ruined and devastated forests existed in almost every province ; also large areas of disafforested and unproductive land ; springs and streams had dried up owing to the destruction of the forest in the Catchment Areas. In these regions land had gone out of cultivation, rivers had silted up as also harbours and small ports on the coasts. And throughout the country unrestricted grazing and firing of the forests was in force ; and shifting cultivation was still practised on a large scale.

The changes came gradually but Conservators of Forests were appointed in the provinces which were still without them between 1860

and 1868 as follows: N.-W. Provinces (now United Provinces) 1860, under Commissioners; 1868 under a Conservator. Central Provinces 1860; Oudh 1861; Punjab 1864; Coorg 1864; Bengal 1864; Assam 1868; Berar 1865. With the increase of work these charges were subsequently split up into several Conservatorships in each of the provinces and presidencies and more recently Chief Conservators have been appointed, some of whom have seats on the Provincial Councils.

The work took time. Trained men were not available at the outset and officers were selected to form the staffs in the different provinces from amongst soldiers and sportsmen who had displayed a liking for a forest life: And very good work they did, several of them writing their names indelibly in the history of the Forestry Department, such as Colonel F. Bailey, R.E., LL.D., who was subsequently my predecessor here as Lecturer in Forestry at the University for 17 years, Colonel G. F. Pearson, Colonel Doveton, Colonel Beddome, Colonel Bingham, Captains Forsyth and Michael. Brandis also obtained permission to select two young fully trained German Forest Officers for appointment to the newly formed Indian Forest Service. The men so selected were Sir William Schlich, K.C.I.E., and Mr. B. Ribbentrop, C.I.E., who joined in India in 1866.

But the training of officers in Europe was commenced in 1866 in France and Germany up to 1885 and thence onwards at home, and the Department has long been staffed by trained officers only.

The subordinate services also grew up. At first this service was confined to the Ranger and Forester class who were specially trained at the College at Dehra Dun which was inaugurated by Colonel Bailey and for many years was the only centre. With the increase of the work of the Department and the sub-division of the forest charges a Provincial Service containing grades of Extra-Deputy and Extra-Assistant Conservator was inaugurated in 1892. These officers are specially trained at Dehra Dun. Later on Training Colleges were founded at Coimbatore in Madras, in Burma and Bombay; whilst elementary schools give training to the Forest Guard.

All this came slowly with constant reorganisation, increase of salaries and so forth. The first graded list of Conservators, Deputy and Assistant Conservators under the Government of India published in 1869 contained 57 officers costing Rs. 94,618 per annum, approximately £10,000. In 1918-19 the total cost of the establishment was £576,000

and included the following cadres :—Gazetted officers, 257; Provincial Service, 260, Subordinate Classes, 3,740; Forest Guards, 11,500.

A Forest Act and rules was promulgated in 1865 and subsequently amended. The forests were demarcated and subsequently surveyed by the Forest Survey, rights were inquired into, the contents of the forests ascertained and in 1884 a special Working Plans branch was instituted. The difficulties facing this work were very great.

The people had been accumstomed to regard the forests as areas in which they could do as they liked. They laid no claim to the ownership of the forest lands throughout the greater part of the country. But with the exception of a few reserved species of tree they had been free to utilise the forests for their own purposes without check. Consequently neither the people nor the Government officials welcomed the advent of the Forest Department. It took years to allay this resentment, but it is now a thing of the past.

Funds were another difficulty. The Government was unable to realise that the stinting of the Department in money meant a retardation in its development. This trouble has now also passed. But the history of the Department has shown that parsimony in making adequate grants is a serious check to the development of a Forest Department and retards the improvement of the Forestry Estate and thereby the coming of the industries which arise in a forest country and give additional employment to the population. The various stages in the growth of an Indian Forest Policy and the Indian Department will be briefly considered as there is much to be learnt from them in building up a Forest Policy in other parts of the Empire.

The survey and demarcation of the forests of India and the subsequent enactment of a Forest Law for the country was preceded by a careful and detailed enquiry into the proprietary rights of the State and individuals into the forest and waste areas in the different provinces. Forest Settlement Officers were appointed and the investigations instituted occupied a number of years and in the remoter parts are not yet entirely completed. The fundamental principle kept to the forefront in these enquiries was the now recognised necessity of ensuring a suitable reservation of forests in each province to make provision in perpetuity for the demands in timber and other produce of the community. In the parts of the country where large tracts of land were only suitable for the growth of trees a forest estate was constituted the produce from

which would be sold in the interests of the State and people. Settlements were also made under which subsidiary blocks of forests in the neighbourhood of villages and small towns in a district were worked entirely in the interests of the local inhabitants to provide small material, grazing, etc., for their requirements. At a later date as the outcome of a long continued series of observations and collection of data on the effects of clearances or destruction of forests in the catchment areas of rivers and streams in the hills and of the devastating effects of erosion on the cultivated lands below, areas of protection forests came into being in which the management was chiefly concerned in maintaining the areas always under trees, no clear felling being allowed, all destructive acts by timber contractors and the local population being prohibited.

The task of protecting the forests was taken in hand and proved an arduous part of forest conservancy. Many years passed and much opposition had to be faced before effectual protection was given to the forests from fire, over-grazing by cattle, and wasteful exploitation of the material.

When these matters had been placed on a sound basis the silviculture of the forests and of the individual species of the great variety of trees they contained began to be studied and with this study investigations into the habits and life histories of the insect and fungus pests to which trees are subject were commenced. This scientific part of the Forest Officer's work is one of great complexity in tropical forests, and careful investigation of the stages by which the subject has been approached in India with the initial mistakes made and the time lost will prove of almost incalculable value to those in whose hands lies the development of the forests in other parts of the Empire. As was the case in India, they are also faced with the difficult work of restoring ruined forests to a more normal condition, and with replanting great areas of waste and barren land formerly covered with forest, and reclothing precipitous hillsides fully exposed to a hot midday sun or to cold winds and so forth. Work in connection with the fixation of shifting sands and the formation of plantations in sandy regions by artificial irrigation, to provide for the requirements of the local agricultural population brought into those areas as a result of the great irrigation works constructed, has also to be undertaken.

To enable the exploitation of the areas of valuable timber forests which, owing to inaccessibility, still remained in the different provinces of India and to enable the improvement of the ruined forest to be taken

in hand, communications had to be opened; roads were made, rocky river-beds were blasted and in some few places export works such as slides, slip-ways, sledge roads and tramways, etc., were built; and, as important, resthouses were constructed in the forests for temporary occupancy by members of the staff whilst on inspection duty throughout their large charges. Permanent quarters for the subordinate staff had to be erected in the vicinity of the forests, a work of considerable magnitude when the area of the forests is taken into account, this area now amounting in British India to 245,600 square miles of reserved forests.

It was in India that the idea of the forest village was, I think, first developed. Difficulties had been experienced in obtaining the necessary amount of labour to carry out the annually recurring work in the forests, such as thinning, climber-cutting, clearing fire-lines, fighting fires, road repairs and so forth. For his chief labour supply the Forest Officer was dependent on the local agriculture population, and he obtained it from neighbouring villages during the slack periods of agriculture. It was found that by concentrating part of this labour in the 'forest village,' to whom a certain area for agriculture and grazing purposes is allotted, the Forest Officer had a first call on the labour which the village could provide and was thus able to depend with certainty on what amounted to a permanent supply of labour at the period when he required it. He is thus to a great extent rendered independent of the great difficulties always experienced in the case of forest work in connection with imported labour. The institution of the forest village is capable of considerable extension both in India and in other parts of the Empire.

With the improvement in the composition of the forest crops and in the management of the forest itself a Working Plans branch was formed and the more advanced forest areas were gradually placed under Working Plans, each plan being specially drawn up for the particular area for which it was made. The placing of the forest area under a Working Plan ensures the continuity of the management of the area on the lines prescribed for a period of years, at the end of which time the plan is revised. When a forest estate is mainly under Working Plans management an assurance is secured by the community that the area is being run on lines which should secure for it the maximum production of which, so far as can then be foreseen, it is capable. Much work of this nature remains to be carried out in India but 60,670 square miles of the forest reserves of the country

(excluding Bombay and Madras) were under Working Plans in 1919 whilst another 18,000 square miles were ready to have plans made for them.

The gradual improvement which scientific conservancy has introduced into some of the forest areas has enabled a commencement to be made with the application of some of the recognised scientific methods of treatment such as the Shelter Wood Compartment System, Group, Coppice with Standard, Selection with Improvement Fellings, and so forth. A beginning only has yet been made and it is the absence of any large areas managed under these standard recognised systems over a sufficient period of years which precludes the possibility of adequately training the Gazetted Staff in India.

In the early years of the present century, on the initiation of Sir Sainthill Eardley Wilmot, then Inspector-General of Forests, a Research branch was formed. Research work in the various branches of Forestry had become imperative if further progress in development was to take place. And in no branch was research more required than in the economic side of Forestry, into the utilisation of many, as yet unmarketable, timbers and of the numerous minor products of the forest. It had proved impossible to expect the executive staff to undertake research work on any scale. The staff was over-burdened with work. Brilliant exceptions there had been; eminent scientific botanists such as Brandis, J. S. Gamble, F.R.S., C.I.E., who is at present engaged on a Madras flora, the late J. H. Lace, H. H. Haines, all having been distinguished Conservators of Forests, had brought honour to the Forest Department. Six posts were made in the Research branch (in 1906), Sylviculturist, Working Plans, Forest Botanist, Forest Zoologist, Forest Economist and Forest Chemist. Careful consideration was given to the form in which the publication of the work of the Research Institute was to be issued and I had the honour to be entrusted with the initiation of this work by the Inspector-General being appointed the first Editor of the Research Publications. They consisted of Memoirs and Indian Forest Records planned on the lines and in the form of the publications of the Royal and Linnean Societies; and of Forest Bulletins and Pamphlets designed to give information collected for the general use of the officers of the Department and for commercial use. 36 Memoirs, 7 Volumes comprising 33 parts of the Indian Forest Records, 48 Bulletins and 16 Pamphlets have been issued by the Institute. Previous to the publications of the Research Institute, Indian Forest literature was very meagre and

scattered and was chiefly confined to the volumes of the *Indian Forester* founded in 1875 by Sir William Schlich and to the Appendix Series of that publication (dedicated to papers of professional interest) inaugurated in 1893 by Mr. Ribbentrop, then Inspector-General of Forests. The success which has followed the inauguration of the Imperial Research Institute at Dehra Dun has proved how great was the want; and other Provincial Research Institutes are now in existence. The Great War brought the value of this new departure into startling prominence, for much valuable economic work was carried out at the Institute by its officers during those strenuous years. That the value of the Research Institute has been fully recognised by the Government is proved by the fact that a large sum is to be expended in the next few years on a great development of the Imperial Institute and by a considerable increase to its staff.

The War also brought about the recognition of the great potential value of the Indian Forests as whole. Funds are to be made available in increasing amounts for development purposes. For years such develpment was starved for want of funds. A new era is about to commence, The net surplus of 1¾ million pounds sterling of 1919 should show a most startling increase when the full effects of the projected working and full exploitment of the great forests, from which in pre-war days the timber of only one or two species was marketable, has come into ull operation.

The forest estate in India is not confined to the forests of British India. There are also some 128,300 square miles of forest in the various Native States including forest lands belonging to private individuals.

The example set by the Government of India in placing its forest estate under an ordered scientific conservancy has not been lost on some of the Native States whose area comprises a large percentage of forest land. Forest services have been set up in these on the lines of the Indian Forest Service and year by year these areas are being brought under systems of management on the lines followed in British India. And not a few of the private proprietors are following the same lead.

The latest development, a departure of the last few years, was the formation of a Utilisation Circle in the United Provinces. Its primary object was to exploit the great almost untouched forests of *Pinus longifolia* situated in the lower hills of the Himalaya and other species in the plains forests and to manufacture the materials extracted on a commercial

scale. The Circle now comprises four charges, *viz.*, The Wood Technology and Woodworking Institute, Bareilly, the Sawmills and Turnery, the Resin and Turpentine Factory, the two latter at Clutterbuckganj, and Forest Engineering. A great part of the necessary machinery has been erected and a thriving new town has come into being at Clutterbuckganj, named after the recently appointed Inspector-General of Forests to whose initiation the new departure was due. A similar circle has since been erected in Burma. This development proved invaluable during the War and is a pre-runner to the more intense exploitment of the Indian Forests which is now contemplated.

In the quinquennial period 1874—79 the gross revenue of the Forest Deparment was about 65 lakhs of rupees, the expenditure about 45 lakhs and the surplus about 15 lakhs. For the financial year 1919-20 the corresponding figures were about 535, 312 and 220 lakhs, respectively. As regards the annual utilisation of products from the forests 174 million cubic feet of timber, 8 million cubic feet of railway sleepers and 173 million cubic feet of firewood were extracted and used in 1919-20 besides 150 million bamboos and canes and very large amounts of various articles of minor produce.

Our interest, then, in the forests of India has extended over a period of some 120 years. During almost exactly half this period we were occupied chiefly in cutting down the teak forests accessible to the parts of the country we were in occupation of. For the rest the natives of India were allowed to continue the ruthless form of exploitation which had been carried on from time immemorial. During the second half of the period we set ourselves the task of conserving, protecting, regenerating and improving by scientific management the forests still existing in the country; of definitely ascertaining the requirements of the people from the forests; in endeavouring to lay down the area of forest which should be maintained in each province; in making adequate provision for the local requirements of the agricultural population, much of which is either given free of charge or on a nominal payment only; in replanting or re-clothing devastated and denuded areas and sandy tracts; and in ensuring that the catchment areas of the rivers and streams should be placed under or maintained under forests, and that erosion in the mountains and hills shall be checked by plantations. As an outcome of the World War a far greater development lies before the Forest Estate of India which it is now recognised can be made to bring in a greatly enhanced annual revenue to the State as a result of an increased expenditure in development.

This is the task and this the position to which the Indian Forest Department has attained as a result of 60 years work. What are the lessons to to be assimilated from this lengthy period by the other forest departments of the Empire? In 1850 the Committee appointed by the British Association considered this question of the destruction of tropical forests and the effects of the destruction. The Members of that Committee confined themselves to the destruction being carried out in the Indian Forests. We are now in a position to regard the matter from the point of view of the forests of the British Empire as a whole.

Both the periods of the history of the Indian Forests alluded to above furnish lessons. There are parts of the Empire at the present moment engaged in operations, or permitting operations, on the lines pursued in India during the first half of last century. Forests are being hacked down *by timber merchants or by the natives of the country, unchecked firing* and grazing is being permitted, and catchment areas are being devastated of trees and the water of springs and streams is drying up and the rivers are silting up and small ports are being put out of commission. A study of the history of our neglect of conservancy in the Indian Forests at first will show the ruin and destruction and the expense of the subsequent rehabitation work, to which this leads; if we omit the fact that a valuable source of revenue to the State and community is being lost.

In other parts of the Empire where the above conditions are non-existent or have been put a stop to there are Forest Departments in their infancy. They have got little further than the stage of the first demarcation of the forests to be constituted reserves; or the exploitment of the virgin forests for large timber of certain species for the market and provision of the smaller local requirements. The number of trained officers in these services is as yet very small. They are at the stage of India about 1870 or 1880. They have everything before them. It can scarcely be doubted that a close study of the lines upon which India has developed or that province of India which most nearly resembles in characteristics their own conditions, will prove beneficial to their future progress and save years which otherwise will be wasted in taking wrong steps, making experiments, and so forth, many of which have been tried in the past in India and failed.

Many of the Heads of the Forest Departments of the Empire met in Conference in London in July last year. Valuable brief Memoranda were submitted dealing with the forestry questions of their departments by the

officers who held charge of them. From these Memoranda, brief as they were, it was easy to realise the exact stage in progress, contrasted with India, to which each had attained. To read these Memoranda and to hear them explained by the various representatives who had drawn them up, was, to one closely acquainted with the history of the Indian Forests, like hearing successive portions of the early part of that history discussed.

It came to me then, and a further study of these Memoranda has confirmed the opinion, that the progress of the Empire Forest Services would be greatly accelerated by a careful study of the stages of growth of the Indian Department.

And though it may not be so apparent as in the case of the semi-tropical and tropical forests of the Empire, the same remark, it appears to me, holds good in the case of the development of the Home Forests and their management. Mistakes made in India in the past, in administration, in staff, in over concentration, in multiplicity of detail, whereby the Forest Officer was transferred into an office clerk seated continuously at his desk, in planting work, in the neglect of silviculture and research and in innumerable other directions, unavoidable mistakes of a developing stage, many of them can be avoided in the case of the younger forest departments of the Empire, once they are put on their guard against the inevitable consequences of such mistakes.

In India a great Forest Department and a Forest Estate of enormous potential value has been built up. India is indebted for this great work to the unwearied interest of successive Secretaries of State for India, to the labour and foresight of successive Viceroys and their Councils and to progressive Governors and Lieutenant-Governors; and, not least, to the unremitting skill, energy and hard work under often trying conditions of the body of Forest Officers, British and Indian, who have held charge of this great Estate and devoted the labour of their active lives to their charge.

COMPARATIVE FOREST STATISTICS.

As far as I am aware no detailed comparison of the forest statistics has been made for the different administraticn of British India.

While making some calculations on a particular point that interested me it occurred to me that a comparative statement would not be without interest for Forest Officers in general and the appended table is the result.

The information was obtained from the "Annual Return of Statistics relating to Forest Administration in British India" for the year 1919-20.

The figures in columns 2, 3, 4, 8, 10, 11 and 18 are taken straight out of that publication; those in columns 5 and 9 are calculated to percentages and in all the others are reduced to averages per square mile of forests of all classes in the respective provinces.

Certain factors, *e.g.*, areas open to grazing and number of cattle permitted to graze, are not susceptible of comparison and these have been omitted.

C. E. C. FISCHER, I.F.S.

25th October 1921.

Province	Area in square miles.	Area of forests in square miles.	Percentage of forests to whole area.	Percentage of area under sanctioned Working Plans.	Expenditure on communications and buildings per square mile.	Total number of breaches of forest rules per square mile.	Percentage of area under fire protection.
1	2	3	4	5	6	7	8
					Rs.		
Bengal ...	78,688	10,632	13·5	45	7	0·30	13
United Provinces ..	106,720	7,471	7·0	57	152	0·60	53
Punjab ...	96,650	6,744	7·0	41	17	1·16	58
Burma ...	226,911	145,764	64·2	7	3	0·04	4
Bihar and Orissa ...	82,578	2,967	3·6	49	29	0·60	72
Assam ...	48,954	21,898	44·7	3	36	0·04	4
Central Provinces	99,948	19,645	19·7	86	15	0·60	53
Coorg ...	1,582	520	32·9	100	408	0·05	32
North-West Frontier Province.	13,184	236	1·8	100	65	6·18	33
Ajmer ...	2,767	142	5·1	100	32	10·30	99
Baluchistan ...	54,228	785	1·4	*Nil.*	0·2	0·26	*Nil.*
Andamans ...	3,143	2,207	70·2	33	46	0·0005	*Nil.*
Bombay ...	123,218	12,579	10·2	62	54	1·53	93
Madras ...	142,263	19,359	13·6	43	34	1·42	82
British India ...	1,080,814	250,949	23·2	24	14	0·35	44

* For one 1

Percentage of failure to protect against fire to area attempted average of 6 years	Outturn of timber and fuel per square mile.	Value of outturn of minor produce per square mile.	Value of forest produce given free or at reduced rates per square mile.	Revenue per square mile.	Expenditure on conservancy and works per square mile	Expenditure on establishment per square mile.	Total expenditure per square mile.	Net revenue per square mile.	Proportion of surplus to gross revenue.
9	10	11	12	13	14	15	16	17	18
	C. ft.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
2·9	2,114	47	15	193	48	43	91	102	53
3·2	4,580	373	74	1,000	645	179	824	176	18
2·2	5,225	392	441	570	264	94	358	212	37
4·9	692	8	5	113	25	20	45	68	60
17 *	6,934	90	103	275	64	106	170	105	38
1·8	648	54	37	68	16	22	38	30	45
1·9	1,810	140	51	231	43	77	120	111	48
5·0	535	63	5	1,823	784	192	976	847	46
12·9	11,797	126	314	1,961	925	353	1,278	683	35
0·08	1,055	426	368	246	176	154	330	—84	...
...	295	57	55	23	5	27	32	—9	...
...	861	1	6	363	395	45	440	—77	...
4·8	3,558	113	160	675	321	149	470	205	30
7·3	1,354	144	4	322	83	108	191	131	41
4·8	1,353	51	35	214	77	49	126	88	41

* (1919-20) only.

CHARCOAL MAKING IN THE CENTRAL PROVINCES.

The following notes describe a method of manufacturing charcoal which the writer trusts will not be found in any text-book but may be of interest as illustrating methods devised by aboriginal genius in violation of all accepted principles.

As an outcome of the chronic shortage of railway wagons and as an economical method of exporting fuel the manufacture of charcoal on a commercial scale was started in the Betul Division in 1918, and has flourished since, the practice having been extended and generally adopted for the conversion of the otherwise unsaleable inferior species from the malguzari forests and our Annual Coupes within a distance of 20 miles from the railway line.

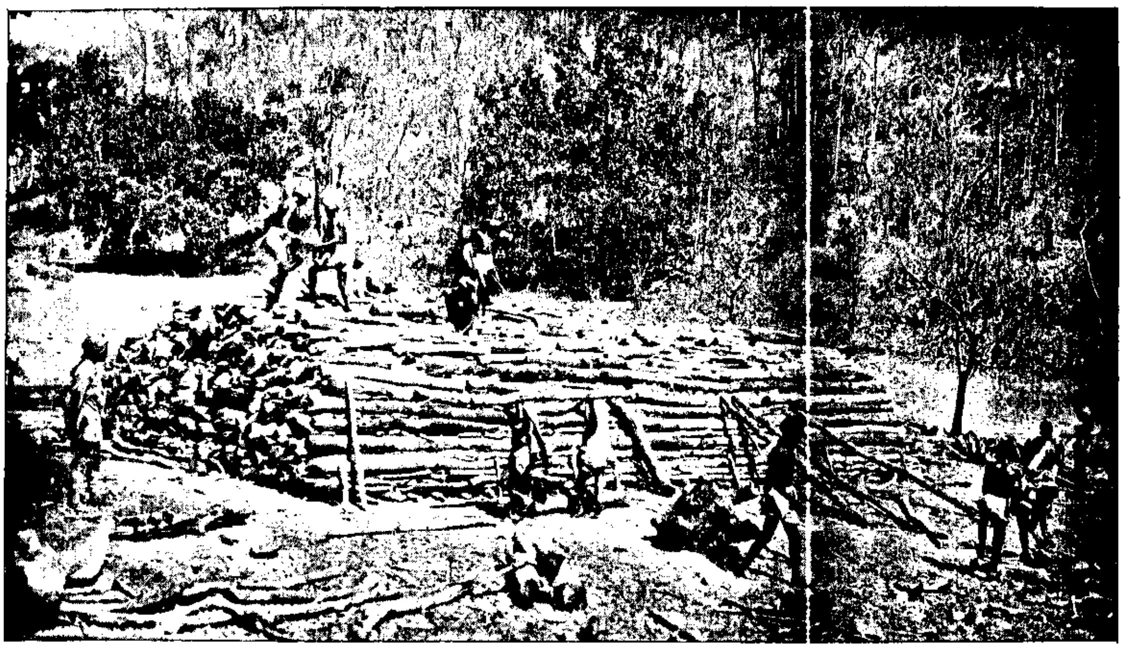
The following are the species commonly used, arranged in order of merit :—

Saj (*Terminalia tomentosa*), Dhaura (*Anogeissus latifolia*), Lendia (*Lagerstrœmia parviflora*), Mokha (*Schrebera swietenioides*), Jamrassi (*Eloœdendron Roxburghii*) and Aonla (*Phyllanthus Emblica*). The last named is not good as it crumbles to powder during carbonisation. Salai (*Boswellia serrata*) and Moyen (*Odina Wodier*) though common are not used.

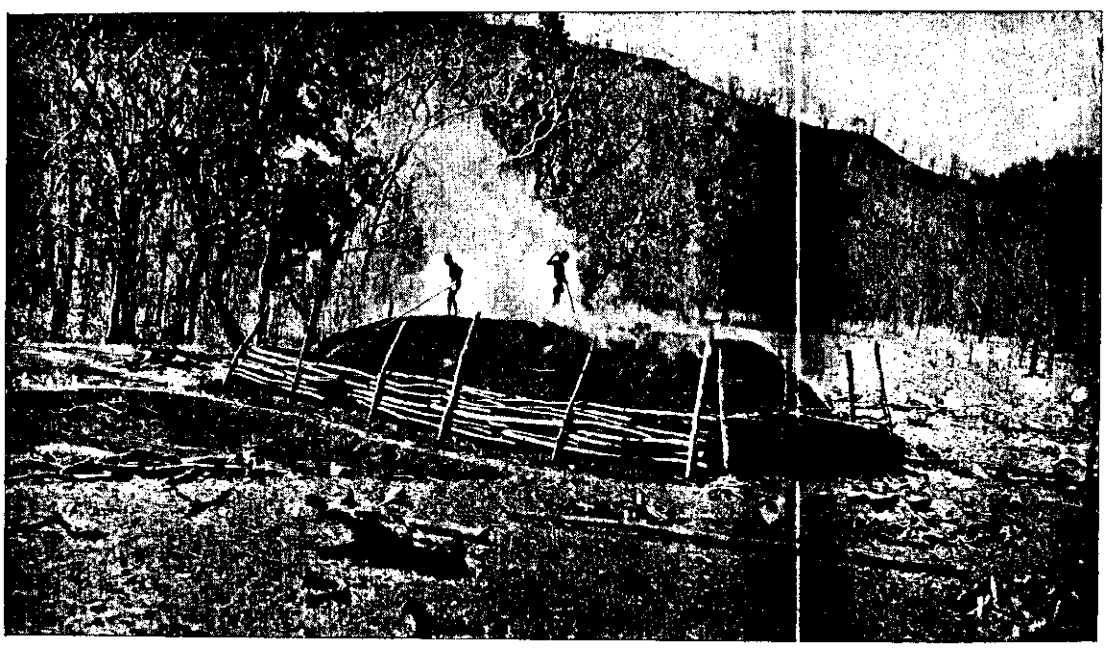
The charcoal is exported mainly to Bombay, and judging from the present wasteful methods of manufacture and the way such manufacture has flourished the business must be a very profitable one.

In order to obtain data for percentage outturn the various processes of constructing, firing, and emptying, an average sized kiln were watched and recorded.

The most striking feature is the unusual size of the kilns and the large size of the billets used. The kiln is roughly rectangular in shape. The one here described measured 35 feet long by 12 feet broad by 8 feet high. Some are much larger than this, and in their construction and the production of charcoal nearly every accepted rule for charcoal making is violated.



Kiln under construction.



The burning kiln with watchers.

The general shape of the kiln is first marked out on the ground. Upright poles are set up at regular intervals on the periphery to act as retaining walls to the fuel. Billets of all sizes are then piled up horizontally on the ground and parallel to the long axis of the kiln. The fuel is mostly used green, the large billets being laid first and the spaces filled up with smaller billets and dry wood. The billets may be of any size from branch wood up to 4½ feet girth and over. In this way the kiln is built up to the required height and shape. The rounded top is then given a layer of dry branch wood and a final layer of green Palas and Jamun branches. With the exception of the two ends the kiln is now plastered with a 6 inch layer of wet mud on which a 2 inch layer of dry earth is finally spread.

During this process both ends remain open and on them dry fuel, leaves, bark and other inflammable material is piled up, fire being set to both ends simultaneously. The fire is allowed to burn for half a day when both ends are sealed up with mud and earth. From now onwards the kiln requires careful watching to prevent fire breaking out. For this purpose two men are required by day and four by night. The kiln actually burnt for 11 days and burst, and had to be repaired no less than five times during this period. *On the 12th day before fire was properly extinguished* or the kiln had been allowed to cool down the ends were opened and the fun began. A stream of coolies were engaged bringing water to dash on the hot charcoal and half burst billets and the hot charcoal was scraped out with a wooden rake and carried off to a stack where again an ample supply of water was poured over it. This watering is considered an important operation as the charcoal is sold by weight! A large proportion of the kiln of course remains unburnt or semicarbonised only and is left over for the next kiln.

Outturn is under such a system naturally low. In this case 2,800 maunds of fuel were used in constructing the kiln out of which 160 maunds or less than 6 per cent good charcoal was obtained, the balance being dust charcoal or semicarbonised and unburnt material.

Profit.—The charcoal is carted to the railway line where it is sold to exporters to Bombay at Re. 1-4-0 per maund who are said to sell it in Bombay at Re. 1-14-0 per maund. In this particular kiln the total expense amounted to Rs. 139. Deducting this from the sale proceeds on 160 maunds at Re. 1-4-0 shows a clear profit of 6 annas per maund to the producer. It must however be remarked that the price of charcoal has since fallen considerably, the present rate being only 10 annas per maund on the railway. So that if the business is to remain a profitable undertaking it will be necessary to remedy the present uneconomical method of manufacture. We are told that the minimum outturn from a properly constructed kiln should be 20 per cent. as compared to the 6 per cent. outturn from the type of kiln here described, so there is yet scope for reforms even in Betul. It now remains to summarise the defects of the present system ' for future guidance.' All kinds of wood are mixed together in the same kiln, the billets being of every conceivable size from branch wood up to 4½ feet in girth and over. No splitting of large billets takes place. The stacking is horizontal and generally loose. This means irregular and incomplete combustion. The method of firing from the open ends is most wasteful. The watering of charcoal is condemned in text-books as it is said to spoil the quality. The local Gond knows nothing of text-books but waters his charcoal liberally to give it a good weight and judging from the price obtained the quality is not impaired. In view of this general practice it would be of interest to the writer to know in what way the watering of charcoal affects its quality.

Though most of the accepted rules for charcoal burning have thus been violated in the operations described above it is yet possible that the system possesses some advantages. For instance the process requires no kind of skilled supervision. The kiln is quickly constructed and on account of its large size the *bulk* outturn is large and it remains to be proved whether such considerations compensate for the low percentage outturn of charcoal.

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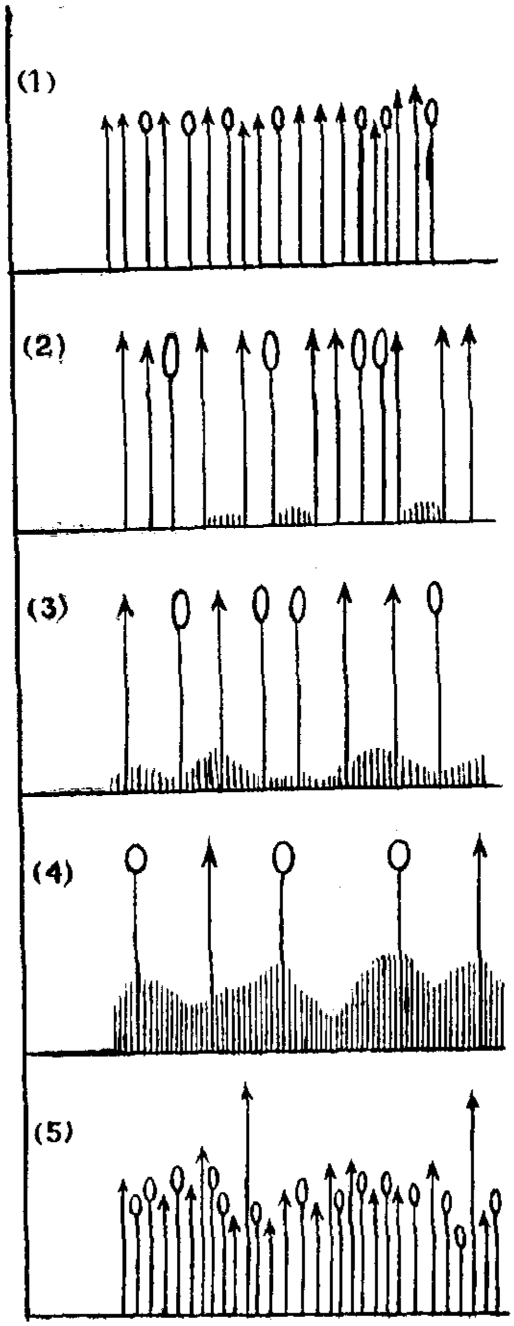
THE FEMELSCHLAG SYSTEM OR THE SYSTEM BY "COUPES JARDINATOIRES."*

(With particular reference to the Bienne forests.)

General description.—This system is largely used in Switzerland for mixed forests of beech, spruce, and silver-fir, and is to all intents and purposes a compromise between the selection system and the method of successive regeneration fellings as applied to even-aged forests in France. It differs from the selection system in that all the age-classes are not evenly distributed over the forest and there is no definite felling cycle ; and from the French system in that the forest is not so even-aged and there are no periodic blocks. There is, however, a regeneration period of indefinite length during which regeneration fellings are made, but this period starts earlier and lasts longer than under the French system, and there is no definite sequence of preparatory seeding and final fellings. The length of this period may be anything up to 50 years and begins during a good beech seed year when the average age of the crop is between 60 and 70 years. Up to this age the crop is kept quite dense so as to clean the trees of branches, to prepare the soil for regeneration and to keep away weeds (see fig. 1). The first light regeneration felling is then made, always

* No recognised French or English technical term appears to exist for "femelschlagbetrieb," which term may be interpreted as a "method of progressive regeneration fellings with a long regeneration period with a view to obtain light increment."

SUCCESSIVE STAGES IN FEMELSCHLAG.



(1) Mixed crop more or less even-aged in appearance 40—80 years old (average 60).

First regeneration felling, or regeneration thinning, made during a beech seed year.

(2) Upper storey aged 60 to 100 (average 80). Groups of regeneration of beech starting to appear.

(3) Upper storey aged 70 to 110 (average 90). Beech regeneration fully established, silver-fir coming up underneath.

(4) Upper storey average 80 to 120 (average 100 = rotation age). Mostly beech and pine standards left. Spruce regeneration coming up in the gaps. Regeneration up to 50 years old and final felling due at any time.

(5) Final felling made, except for isolated pines left over for next regeneration.

Young crop irregular in appearance but soon evens up to stage (1).

Blanks filled up artificially with light demanders.

during a good beech seed year, with the object of letting in sufficient light to allow the seed to germinate. This felling is however really very light and only a thinning. If all goes well, small groups of beech regeneration will appear in a few years time—fig. 2—and if not the canopy will have closed in again sufficiently to prevent undue exposure of the soil or the formation of weeds. Once the groups of beech regeneration have started they are gradually opened up until normally the beech regeneration will have spread all over the area by about the age of 100 years—fig. 3. If, however, the first regeneration felling does not produce regeneration it will be repeated at short intervals, always taking care to avoid over-exposure, so that ultimately regeneration is practically always obtained. The regeneration is then allowed to grow up under the old wood which is gradually reduced until the final felling is made when the young crop is anything up to 50 years old—figs. 4 and 5. When this final felling has been made the young crop presents a very irregular appearance, but by the time it has reached the stage shown in fig. 1 it has evened up again in the most remarkable manner.

Silviculture.—The object of the system is to regenerate mixed forests of beech, silver-fir and spruce, hence regeneration is started as soon as the trees start to bear good seed, *i.e.*, when the average age of the crop is about 60 years. The object of the first regeneration fellings is to obtain beech regeneration in small groups, which are then gradually opened out until more or less complete beech regeneration has been obtained over the whole area. Once the beech regeneration has been obtained it is found that the silver-fir comes up under the beech and soon tends to dominate it, so that in order to retain about ⅓ to ¼ of beech in the final crop, it is necessary to start with almost complete beech regeneration. Having then regenerated the beech and silver-fir, heavier fellings are made to give the spruce a chance, but owing to the prevalence of heart-rot among spruce, a large percentage of spruce is not required. The sequence of the regeneration is then first beech, then silver-fir and finally spruce. Any blanks

left when the final felling is made are filled up with spruce if there is a deficiency or with fast growing light-demanders such as Douglas Fir, Weymouth Pine, Scots Pine, etc. During the whole of the regeneration operations the progress is cautious so as *to reduce wind-damage*,* soil exposure and weed-growth to a minimum. Hence these operations are started as soon as the trees are able to bear good seed, *i.e.*, at about 60 years old. Such careful progress and the long period therefore render practically complete regeneration almost certain.

Light Increment.—In addition, however, to ensuring regeneration by starting operations early, the other object of the method is to obtain the maximum growth due to light increment on the upper storey. This upper storey is therefore retained as long as is possible without injury to the young growth, and the final crop consists of the very best trees placed under the best conditions for maximum growth. At the end of the rotation these trees will consist mainly of beech, which have somewhat lighter crowns than the conifers and are also less liable to heart-rot and wind-damage. Theoretically one would expect that the retention of this upper storey for so long would result in the suppression of the young crop, but this is not the case at all in practice where no signs of suppression are to be seen. Also one would imagine that the removal of the large trees in the final fellings would do immense damage to the young crop. This, however, is avoided by removing the final crop gradually, and by means of departmental extraction using only expert permanent wood-cutters who have the interest of the forest at heart and who remove the crowns of the trees before felling where considered necessary. Under the French system of selling the trees standing, however, this system is almost impossible, and Swiss foresters absolutely scorn the idea of allowing contractors' men to enter their forests and smash them up as they feel inclined. The Swiss system is to mark the trees for felling and then to inspect them in company with the purchaser who contracts to purchase these particular trees at a certain price per

*At Winterthur and other places regeneration proceeds against the prevailing wind as far as possible.

cubic metre felled and extracted to the forest roads. The Forest Officer then does his own felling and extraction with his own men, and delivers the timber to the purchaser on the forest roads according to its actual measured volume at the price per unit already agreed upon, which of course includes the cost of felling and extraction carried out by the Forest Officer. This system is advantageous to the timber merchant in that he purchases his timber by the actual and not the estimated volume and to the Forest Officer in that he saves his regeneration, and at the same time never fells any trees until he has contracted for their sale.

Thinnings and Cleanings.—These are carried out in the young forest until about the age of 60 years and are run on an approximate thinning rotation of 5 or 6 years. There is, however, no definite table of thinnings laid down in the working plan. The volume to be removed in thinnings during the 10 year period is laid down as an addition of 35 per cent. to the possibility for principal fellings. These thinnings are light and aim at height-growth in the young crop without unduly sacrificing the crowns.

The possibility.—The possibility is fixed as the result of the enumeration of the whole forest over 60 years old (16 cms. diam.) and is calculated by means of Heyer's formula checked by Hundeshagen's formula—see table 1. The period is usually for 10 years and a table of cuttings—see table 2—is made out for the 10 years showing where these cuttings are required and the volumes which are available for cutting. This table shows the total volume which is to be cut during the period, and also the areas where it is available, these areas being scattered all over the forest according to the silvicultural state of the crops. Each year a certain part of the periodic possibility is cut, the actual amount depending upon the progress of the regeneration and the state of the timber market. The Forest Officer has therefore almost complete freedom in making his annual fellings provided that he has cut approximately his calculated periodic possibility by the end of the period. If the rotation is 100 and the period 10 the area covered should also be somewhere near $\frac{1}{10}$ and is used as a check on the volume possibility, At the end of each year a control form is filled up to

show the Forest Officer how much of his volume has been cut and how much is left and what areas have been covered and what areas remain untouched. He therefore always knows what volume (and area) he has left for the remainder of the period.

Advantages.—The system has therefore numerous advantages:—

(1) *It is admirably suited to the regeneration of mixed woods of shade bearers*, and produces excellent results when applied to such woods.

(2) By starting regeneration operations early *the new crop is anything up to* 50 *years old by the end of the rotation, thus saving much time*.

(3) *By starting regeneration early the chance of ultimate failure is minimised*, and the very gradual opening up of the canopy prevents wind damage and at the same time reduces the risk from weeds to a minimum.

(4) *Full advantage is taken of the light increment of the old trees*, which put on an enormous increment towards the end of the rotation. Light-crowned wind-firm species such as Scots Pine may be retained over two rotations.

(5) *The method is extremely elastic*, allowing the Forest Officer to carry out each year those operations which are most suited to the silvicultural state of the crop and to the prevailing market conditions. The calculation of the possibility by Heyer's formula also tends to produce the normal stocking in the forest.

(6) *It is an excellent preparatory system if it be desired to convert even-aged forests into selection forests.*

Disadvantages that may be urged against the method are:—

(1) *The scattered nature of the fellings.*—This is obviated to a great extent by a good system of roads and the objection has little weight in any but large forests.

(2) *Suppression of the young growth.*—This does not occur in actual practice.

(3) *The necessity of departmental extraction.*—To Swiss foresters the idea of selling trees outright standing and allowing

untrained contractors' men into the forest is so abhorrent that the objection carries no weight—in Switzerland at all events.

(4) *The method requires a good forest officer.*—This is true, but with a bad forest officer no method will give good results.

This system of Femelschlag is greatly in favour in Switzerland where it is considered an excellent system in itself but also an almost essential stage in the progress from even-aged to selection—a progress which is finding more and more favour among Swiss foresters many of whom, including the advocates of the method of control, consider that for shade-bearers the selection forest is economically and silviculturally the ideal.

An excellent example of the application of the method is to be seen in the Communal Forests of Bienne which have been managed by that master of the method M. Muller, during the last 40 years and are now an object-lesson in forest management. The system can be modified to make it applicable to mixed forests containing light-demanders. An example is to be seen at Buren where there is a mixed forest containing a dominant stage of oak and a mixed under-wood of conifers which are cut as soon as they threaten the oaks. In some places in this forest, particularly in the shade of spruce, good groups of oak regeneration have appeared which could probably be enlarged and spread over the forest in the usual Femelschlag manner. The system has not, however, been applied very largely to forests containing light-demanders—except for filling up blanks artificially with pines, larch, Douglas fir, etc., and in its simpler form is really essentially designed for the mixed forests of shade-bearers so common in Switzerland. In the Sihlvald it is now also being applied to almost pure beech forests.

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APPEN

Sample Table of Volume of the Growing Stock and

Locality and compartment.	PRESENT ALLOTMENT					
	CLASS I, 1—20 YEARS.		CLASS II, 21—40.		CLASS III, 41—60.	
	Hect.	M³.	Hect.	M³.	Hect.	M³.
Vingelsberg 1a	...	...	2·40	240	...	...
	...	...	...	...	...	...
Vingelsberg 1b	...	...	4·96	595	...	...
	...	...	...	...	...	...
Vingelsberg 1c	...	...	...	...	...	...
	1·18	...	...	...	...	...
					Recapitulation	
Vingelsberg	25·08	...	39·34	5,123	15·95	2,635
Malvaux Sud	20·95	...	20·00	3,066	44·22	14,356
Malvaux Nord	40·20	...	73·11	10,464	13·00	2,990
Cherruge Chalet	31·00	...	80·42	10,879	18·00	4,470
Jorat Noir	15·06	...	20·05	2,855	22·35	6,590
Total ...	132·29	...	232·92	32,388	113·52	310,41
Normal area	147·61	...	147·61	...	147·61	...
Difference	−15·33	...	+85·30	...	−34·09	...

Calculation of

Actual Total volume

Normal Total volume

Deficit

DIX I.

Calculation of the Possibility. Communal Forest of Bienne.

OF AGE CLASSES.

Class IV, 61—80		Class V, 81—100.		Class VI, over 100		Total.	
Hect.	M³.	Hect.	M³.	Hect.	M³.	Hect.	M³
...	...	...	...	...	...	2·40	240
9·62	3,735	...	...	...	...	9·62	3,735
...	...	...	...	...	...	4·96	595
...	...	11·60	5,658	...	...	11·60	5,658
4·75	2,141	...	...	...	...	4·75	2,141
...	...	...	...	...	...	1·18	...
and Totals.							
43·34	16,561	59·41	16,561	...	...	175·12	51,980
54·99	23,022	54·99	23,022	...	...	169·37	57,946
...	...	9·74	8,252	...	...	136·05	21,706
18·14	5,341	32·05	14,193	...	...	179·61	31,883
10·30	3,915	10·16	4,634	...	...	77·92	17,995
126·77	48,839	132·57	72,242	...	...	738·07	1,84,510
147·61	...	147·61	...	...	...	...	...
−20·84	...	−15·04	...	...	...	...	...

the possibility.

= 1,84,510 m³.

= $\frac{3,942 \times 100}{2}$ (by formula $\frac{V}{n} = \frac{I}{n} \times \frac{r}{2}$.)

= 19,7,100 m³.

= —12,590 m³.

Sample Table of Volume of the Growing Stock and Calculation

Locality and compartment.	INCREMENT			
	Actual.		Normal.	
	Total.	Per hect.	Total.	Per hect.
Vingelsberg 1a	12	5	12	5
	48·1	5	48·1	5
Vingelsberg 1b	24·8	5	24·8	5
	69·6	6	69·6	6
Vingelsberg 1c	28·5	6	29·5	6
	5·9	5	5·9	5
			Recapitulation and	
Vingelsberg	905·1	5·1	900·3	5·2
Malvaux Sud	990·9	5·9	1,000·8	6·0
Malvaux Nord	818·1	6·0	318·3	6·0
Cherruque Chalet... ...	834·4	4·6	339·2	4·7
Jorat Noir	358·0	4·5	374·3	4·8
Total ...	3914·5	5·2	3941·9	5·3
Normal area	...	...	...	...
Difference	...	...	...	...

(1) *By Heyer's Formula*

(2) *By Hundeshagen's Formula*

(3) *Area Check*

of the Possibility. Communal Forest of Bienne--(*continued*).

Species and Proportion.		AREA CHECK. Period I, 1914—34. Area.	AREA CHECK. Period II, 1934—54. Area.
Beech 6. Field Maple, Oak, etc., 4 ...	...	...	...
Beech 7. Oak 1. Elm 1. Others 1 ...	...	3·0	4·0
Fir 7. Beech, Oak, etc., 3 ...	...	...	...
Fir 3·5. Doug. 3. Oak 3·5. Beech 1 ...	...	1·5	4·60
Beech 4. Larch 1. Doug. 3. Oak, etc., 2	...	1·2	2·00 etc.
Beech 7. Fir, Maple and Ash 3 ...	...	...	...
Totals—(*continued*).			
...		43·03	44·72
...		47·25	49·06
...		9·74	8·00
...		29·85	30·50
...		17·66	17·00
...		147·53	149·28
...		147·61	147·61
...		...	...

$$P = I_r + \frac{G_r - G_n}{a}$$

$$= 3914 + \frac{1{,}84{,}510 - 1{,}97{,}100}{40}.$$

$$= 3914 - \frac{12{,}590}{40} = \underline{3{,}600\ m^3}$$ per annum or $\underline{36{,}000\ m^3}$ for the 10 year period.

$$P = \frac{I_n}{G_n} \times G_r = \frac{3{,}942 \times 1{,}84{,}510}{1{,}97{,}100}.$$

$$= \underline{3{,}690\ m^3}.$$

$P = 3{,}900\ m^3 =$ increment.

APPENDIX II.

Sample of Table of Cuttings. Forêt de Bienne. Period 1914—1924.

Locality and Compartment.	Sub-division.	Period 1914—1924. Area for fellings.	Volume per hect.	Increment per hect for ½ period.	Vol. available for cuttings.	Nature of Coupe.
		hect. (1)	m 3 (2).	m 3 (3)	m 3 (4)	
				(col (1) × col, (2)) + (col. (1) × col(3)).		
			Vingelsberg			
unter d. Brunneling	1a	2·50	390	25	1040	Freeing groups of young growth.
„ Wersshausweg	1b	3·50	490	30	1,820	Do.
Buchenfleche ...	1c	1·50	450	30	720	Do.
ob. d. Wersshausweg	2	5 00	570	32	3,010	Do. and opening conopy.
unt.	2	1·00	430	32	462	Do.
Gärteli ...	3	2·50	590	27	1,542	Freeing young growth.
ob. d Flih ...	4	1·00	410	25	435	Do. and opening canopy.
ob d. Michelobysm	4	1·50	480	27	760	Do.
unt d.	4	1·50	290	25	472	Do.
ob d. Kushansweg	5	2·00	600	25	1,250	Removal of old silver-firs.
unt. d. ...	5	2·00	540	22	1,124	Do. and freeing young growth.
Bädeli „ ...	6	·60	400	32	259	Freeing young growth.
Wolfenbanke ...	7	·50	400	20	210	Removal of stunted growth.
Total for Vingelsberg		26·10			13,634	
		Remaining totals are :—				
Malvaux Sud		20·50			10,857	
Malvaux Nord		3·60			3,169	
Cherruque Chalet		11·50			5,313	
Jorat N. Combe		7·00			3,027	
Grand Total		68·70			36,000 m3	

These volumes and areas are approximate only, and total the calculated possibility, $36{,}000m^3$, see Appendix I. The volumes and areas may be cut in any order desired following the silvicultural development of the crop and the state of the market, but the total cut in the 10 years must equal $36{,}000m^3$ app.

Small areas are also taken from all parts of the forest if silviculture so demands.

Intermediate yields are calculated as being equal to 35 per cent. of the possibility and amount to $36{,}000 \times \frac{35}{100} = 12{,}600m^3$ for the 10 year period.

The area is used as a check and in this case is rather less than the normal proportion for the 10 year period assuming the 100 year rotation.

i.e., actual area is 68·70 hect.

Normal area is $\frac{738{\cdot}07 \times 10}{100} = 73{\cdot}81$ hect.

In the upper regions of the Sutlej valley is a mighty mountain, the Lesser Kailas of the geographers, with its head in the clouds 22,000 feet above sea level and its roots in the Sutlej fifteen thousand feet below, and buttressed on all sides by immense precipices. The summit is sacred to Shiv and is inhabited by the souls of the dead, untrodden as yet by the foot of man and likely to remain inaccessible and unclimbed for generations to come. Round it devout Hindus make a toilsome and difficult pilgrimage in order to release their dead relations from the punishment their souls suffer for their misdeeds on earth. Under the eternal snows and glaciers, and in the precipices lives Kali, the destroyer, who is universally worshipped and dreaded by the simple inhabitants of the Hills.

The slopes of Kailas are steep and precipitous and throughout the monsoon avalanches are of daily, and almost hourly occurrence; clouds are condensed on the glaciers and upper slopes and torrents pour down the *khads* forming sudden floods, whose advent is announced by a noise like thunder and the very earth

trembles, while trees are uprooted, bridges are swept away and great rocks are carried down the streams by the violence of the waters. Little is it to be wondered that in the eyes of the Hill men Kali occupies the principal position amongst all the gods of the Hills, and owing to her grace and favour man is enabled to escape from the numberless dangers which surround him, and numerous are the offerings made to the goddess by the terrified villagers. In the woods lives the Bunshir, the demon of the jungles, who changes his shape at will and is often seen climbing amongst the trees in the shape of a bear, a monkey or a little old man with his beard low down on his chest and of whom all men must beware.

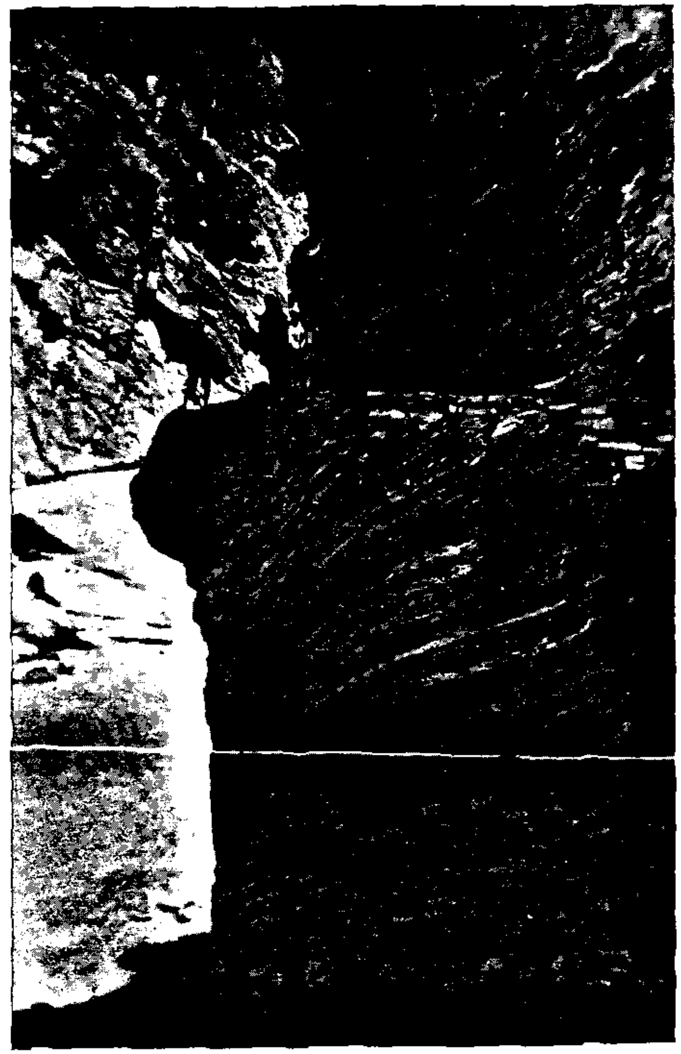
Worse than he is the "bhut" who inhabits the precipices, a very terrible spirit whose cries and screams in the dead of night cause the flocks suddenly to scatter and shepherds to tremble with fear; avalanches suddenly rush down the hill-side and overwhelm the unwary traveller; the foot slips on the edge of a precipice and man is precipitated into the depths beneath; or a rock suddenly falls down the hill-side disturbed by no visible agency, sweeping everything in its path to the raging river far below.

This "bhut" is never seen and approaches behind the unsuspecting man, who if he escapes death, is rendered mad for a season. Above the greatest of all the precipices lies the village of Mehbar, "perched as in a swallow's nest on the eaves of the roof of the world" as so concisely and graphically described by Kipling in his immortal "Kim." Twice has this village been practically destroyed by avalanches whilst the temple of the "deota" Meshir has escaped, so it can easily be understood that the inhabitants of this tract worship Kali the destroyer as the most potent of all gods and that at the shrine of Meshir prayers are offered, oblations are made and goats are sacrificed, as it is through his intercessions that Kali is propitiated and the activities of the subservient demons are confined within reasonable bounds.

Consequently it was with dread that the villagers learnt in 1913 that Government had determined to cut through the Karcham

Photo.-Mech. Dept., Thomason College, Roorkee.

The Home of the Ralli Demon.



The Ralli Cliff.

and Ralli cliffs in order to open a road to the valuable deodar forest in the upper parts of the Kailas range. The alignment ran close to the Sutlej river and the road had to be built straight through the steepest and most dangerous of all the precipices in Kailas; with all the malignant influences at work it was freely prophesied that the road would never completed and that death and destruction would result to those engaged on its construction.

This is little to be wondered at, for the road involved great constructional difficulties, and after each accident the coolies bolted and would not come back to the work until numerous goats had been sacrificed at the temple of Meshir, the servant of Kali, the goddess of destruction.

The forest staff is recruited locally for the most part, and it is much to its credit that it continued to work fearlessly in face of dangers, both real and imaginary, when one accident after the other happened, as the terrors of the malignant spirits must have seemed very real to the forest guards engaged on the work, and especially terrifying to the local coolies everyone of whom was crammed full of superstition and filled with a very real dread of the powers of the evil spirits. Kahan Singh, a forest guard, in 1913 was first blown up by a dynamite explosion, followed in 1914 by Ram Singh, forest guard, who when warming dynamite in the winter at a fire incautiously dropped detonators into the fire from his waistcoat pocket. One guard was also rendered deaf for life and his hand was smashed and another was twice rendered senseless but recovered. Hari Lal, forest guard, was hit on the head by a falling stone and fell down a cliff in 1915, after which work was temporarily abandoned on account of the War. Work recommenced in 1918, and as forester Narain Singh commenced repairing the approaches to the Ralli cliff of which photographs are given, an avalanche swept away part of the village of Mehbar 3,000 feet above him and buried him under tons of rocks, melting snow and earth, together with a watcher named Rattan Bhag and the road mate. Needless to say the labour bolted and as on former occasions did not return until its terrors had been assuaged by the sacrifice of many goats.

The Ralli precipice was absolutely sheer and vertical, and although the Bashahri has lived on and among precipices all his life but two men in the whole Sutlej valley could be found daring enough to face the perils of the cliff. Jumpers were driven into the rocks above the cliffs, ropes were slung from these, to which boards were suspended, and gradually the work of blasting was done under the greatest difficulties, and by the end of 1920 the cliff consisting of a quarter of a mile of sheer precipice was cut through, though the road has been finally completed only this year, (1921). Not, however, without many difficulties successfully surmounted and frequent accidents ; while the scourge of influenza visited this work in 1918 and seven labourers died on the work. One more man was blown up by dynamite, three others were killed by falling rocks and Ram Guru, the forest subordinate, who had been one of the two men who alone would climb on the Ralli *dhank* died of consumption.

Worst of all when the road had rounded the corner of the Ralli precipice a huge cavern, of which the existence had been till then unsuspected, was revealed, and in it was a heap of husks of buckwheat carried by pigeons. It was firmly believed that the actual residence of the "bhut" had been penetrated and that these were the remains of the grains which he nightly stole from the fields.

The road is about 7½ miles in length, most of the way through sheer cliffs and rocks and is 6 feet wide : the Ralli precipice was a quarter of a mile in length and cost Rs. 16,000. The alignment was good and the road is now open for mule traffic and reflects great credit on the Range Officers concerned, three Sikhs and one Hill Rajput, the foresters, guards, and, most of all, the Bashahri coolies employed, who for six to ten annas a day repeatedly risked their lives in its construction. As a record of persistent endeavour and of difficulties successfully surmounted it would be hard to beat this accomplishment in the annals of the Punjab Forest Service.

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NOTE ON SOME ASSAM RAIN FORESTS.

The forests in the Eastern end of the Assam Valley excluding parts of the Nowgong district and the Mangaldai sub-division of Darrang are Evergreen Rain Forests. Except on certain of the hills they nowhere contain large continuous areas carrying a heavy stand of timber. The best stands of timber are found always in belts generally only a few hundred yards in width on the best drained and richest soils along the lines of drainage such as rivers and other subsidiary water channels. Such belts are not continuous or of uniform width. Also, especially in the Dibrugarh sub-division of the Lakhimpur district, good stands of Hollong (*Dipterocarpus pilosus*) or Hollock (*Terminalia myriocarpa*) and Jutuli (*Altingia excelsa*) are often found in broken ground, which forms the sources of small drainage channels. So soon as one moves out on to high flat land away from these drainage lines one gets a stand consisting of Bazal bamboo (*Pseudostachyum polymorphus*) or Kako (*Dendrocalamus Hamiltonii*) bamboo with scattered trees singly or in groups, the whole except the Kako bamboos covered with a more or less dense growth of climbers. Or as an alternative we may get simply a dense blanket of climbers supported here and there by single trees or groups of trees generally of small size. I am of course trying to give a very general description, I do not expect it to agree in detail with any special area which may be called to mind and I also refer only to the plains.

The soil in areas bearing such a poor stand is not bad. I have over and over again seen such areas cleared for tea cultivation and seen them producing good crops of tea.

Why then should we not find these areas producing a good crop of timber? For years my idea was that these areas had, some comparatively few years ago, been cultivated and had not had time to regenerate themselves successfully. Lately I have been through many such areas which cannot certainly have been cultivated in any way for, at all events, 150 to 200 years if they have ever been cultivated, I have also been studying the rate of

growth of some of the better timber trees and find it is very fast, also the age of such trees seems very small, I seldom if ever remember to have counted more than 100—120 rings for any tree even of large dimensions. The maximum growth also seems generally to end about the age of 40—50. I am now of course referring to trees growing away from the hills, so soon as hilly ground is approached the rate of growth is generally slower and the age increases. This would therefore seem to show that such poor timber crops are not the result of secondary growth.

My present idea is that the reason is summed up in the two words "climate" and "climbers." The continuously moist (rain climate occurs in all months of the year except as a rule November) enables the semi-herbaceous and shallow rooted climbers to outgrow without a check the deeper rooted and consequently slower developing timber tree and suppress it. It is only where a seed from a timber tree happens to fall on a piece of soil which is especially suited to its development as a seedling that a tree is found at all. This is also borne out by results obtained in making sowings in the forest—the growth of seedlings within a few feet of one another will vary tremendously and a seedling self-sown will generally show far faster growth than a hand-sown seedling within a few feet of it. Simply I believe that the self-sown seedling only exists at all because it happens to have fallen on soil specially suited to it. So soon as the roots begin to spread and cover a larger area this difference tends to disappear.

The reason for trees seldom reaching a great age in such forests, I also attribute to climbers smothering and killing them as soon as the rate of growth slackens off. The climber's weight soon breaks the tree or causes it to be blown down by the wind and it rapidly decays. This theory, if correct, would have a considerable effect on regeneration policy. I should be very glad if any reader having experience of similar forest would give his view on the matter.

H. L. COOPER, I.F.S.

FERRETING IN BURMA.

My title is rather misleading as the reader might expect to hear how rabbits are caught but I would ask him to wait until he has read to the end before he condemns it.

The Sundarbans is a well-known name to most people but the Burmese language, prolific as it is in words, cannot supply a similar name to the forests of the Irrawaddy Delta much superior though they be from a forest quality point of view to the Bengal Sundarbans. Even the delta is described only as "mye hnu kyun paw" which merely means "islands appearing owing to deposit of silt."

The islands on which the forests grow are well south of the latitude of Rangoon and with the exception of the reserves, an area of 1,000 square miles, the whole area is rapidly being brought under paddy. The Forest Department has been somewhat late in trying to get control over the excellent forests which once covered these fields, with the result that they have provided an easy supply of fuel for Rangoon.

And this is where our trouble arises. Not only have the unclassed forests been cleared, but reserves are being cleared as well. They are officially protected and no licenses are issued for extraction but nevertheless, probably at least as much as, possibly even more than the annual yield of the forests is being removed. The experienced Divisional Forest Officer accustomed to a division where he has possibly 50 or 100 offences a year and few of these for cutting illicitly in reserves, would probably suggest that it should be stopped by putting on more subordinates. Subordinates, however, rather enjoy exercising the powers of compounding under the Forest Act, supposed to be reserved for certain higher officers. It is not therefore so simple as it looks. The Divisional Forest Officer has to do his best to detect forest offenders himself. This is where the ferreting begins.

The islands are cut into a network of small streams and at high tide very few places cannot be reached in a small boat. The fuel thieves are of two kinds, the one comes from Rangoon and

other big towns in sampans, gets well into the middle of the reserves by night and ties up in one of the small streams. He will be unfortunate if he is caught there and he gets out again by night into the main stream. Once there if caught, he will have cut his fuel from one of the small exclusions with which the reserves are unfortunately blessed. We sometimes ferret these people out but as the ordinary boatman from the towns considers the cutting of fuel too much like hard work, there are not so many of this kind. The other kind is made up of the riffe-raff of the country, who have no cattle, fields, etc., and will do anything for an advance of money. The Chinese shop-keeper is the very man for this sort of thing and he has established himself all over the place within a few yards of the reserve boundary. He does not usually advance money but sells his wares, opium, rice and other necessities for fuel. Fuel in fact becomes the current coin of the district. One method of procedure is for two men to go into the reserves after their morning meal, fell the trees and cut them into short lengths. One of the family will come with them to bring back the boat lest it be too conspicuous a mark for any subordinate patrolling round. Next day at high tide the fuel is brought out in boats and stacked near the village. As there are probably a few trees standing in the fields, any such fuel has of course come from the unclassed forests.

When any forest officer appears, some one on the alert beats the village drum or blows a horn and the men inside the reserve disappear for a bit. The only way is to come down quietly, place a man in the village to prevent the alarm being given and then ferret the rabbits out of the warren. We usually have the motor boat and half a dozen small boats. The former goes up the large streams and drops one boat at each small one. A stream ten feet wide may extend for half a mile into the forest. The motor boat meantime moves up and down to see that none escape from the small streams into which the forest subordinates or ferrets have not yet entered. Once the rabbit or rather the boat full of wood is seen, the game is not finished, as it is a simple matter to sink the boat loaded as it is, and disappear into the jungle. Sometimes we

get the boat. In other cases, the men are seen in the forest cutting up the trees. They too often get away, as it is no joke chasing them over the tent peg air roots which cover the grounds. Sometimes the husband and wife and a host of children are caught and then the puzzle is what to do with them. In other cases, the family erects a hut at the very source of one of the small streams, which can be reached only at high tide, live there and cut fuel while some trader advances money beforehand and sends his sampans in by night to remove the fuel.

Once the rabbits have been ferreted from their holes, they are generally placed in cages with the door open, so that when a summons comes along, they have disappeared to some other warren. Sometimes we cut off their tails by compounding but lately we have been taking the cages up to the man with the gun—the Magistrate—and opening them before his nose. He unfortunately is usually a very bad shot and merely gets a few hairs out of their tails with a fine of Rs. 10.

We only hope that the new regulations and a new breed of ferret may do something to make the rabbits change their diet. If anyone would like the job of game-keeper, applications will be welcomed.

A. W. M.

TRADE NAMES FOR INDIAN TIMBERS.

A paper was read by Mr. A. Rodger at the recent Utilisation Conference in Dehra Dun on the advisability of having a standard set of trade names for all Indian timbers likely to find a market outside India.

The Conference appointed a sub-committee to draw up a list of suitable trade names and the list given below is the result. The names have been selected with a view to avoid confusion with existing trade names by taking either the most easily pronounced vernacular name or an English name not already used for any other species. On this basis the list received the general approval of the Conference, to whom were submitted the most difficult names to decide.

Copies of this list will also be circulated to Forest Officers for any criticisms and suggestions they may have to make. It is hoped that they will bring to the notice of the Forest Economist any timbers which have been omitted from the list and which are likely to be exported in the near future.

As it is proposed to use the final list at the 1924 Exhibition it is hoped that correspondents will send their suggestions at an early date.

It was resolved at the Conference that when all replies had been received a committee of officers of the Forest Research Institute should be appointed to consider them and that the list approved by the Committee should be the official list of names for Indian timbers.

Proposed trade names for Indian timbers as accepted by the Utilisation Conference held at Dehra Dun in January 1922.

In the following list no timbers belonging to different genera have been given the same trade name, with the exception of the Burmese species *Pentacme suavis* and *Shorea obtusa* whose timbers virtually indistinguishable and by local usage have been considered equally useful.

Closely similar timbers belonging to the same genus have been grouped under the same trade name where it appeared to the Conference that there was not sufficient industrial difference in their use to justify allotting a separate name to each species :—

1.	Abies Pindrow ...	...	Himalayan Silver Fir
2.	Acacia arabica ...	...	Babul
3.	„ Catechu ..	...	Cutch
4.	„ ferruginea	...	Kanti
5.	Acer spp. ..	...	Himalayan Maple
6.	Acrocarpus fraxinifolius	..	Mundani
7.	Adina cordifolia	...	Haldu
8.	Æsculus spp. ...	...	Indian Horse Chestnut
9.	Afzelia bijuga ...	...	Shoondal
10.	Albizzia Lebbek	...	East Indian Walnut
11.	„ odoratissima	...	Black Siris

12.	Albizzia procera	...	White Siris
13.	Alnus spp. ...	...	Indian Alder
14.	Alstonia scholaris	...	Shaitan wood
15.	Amoora spp. ...	...	Amoora
16.	Anogeissus acuminata	...	Yone
17.	„ latifolia	...	Axle wood
18.	*Anthocephalus Cadamba*	...	*Kadam*
19.	Aquilaria Agallocha	...	Eagle wood
20.	Artocarpus Chaplasha	..	Chaplash
21.	Artocarpus hirsuta	...	Aini
22.	„ Lakoocha	...	Lakuch
23.	Barringtonia acutangula	...	Chee
24.	Beilschmiedia sikkimensis	...	Indian Tawa
25.	Berrya Ammonilla	...	Trincomalee wood
26.	Betula spp. ...	...	Indian Birch
27.	Bischofia javanica	...	Bishop wood
28.	Bombax insigne	...	Didu
29.	„ malabaricum	...	Semul
30.	Boswellia serrata	...	Salai
31.	Bucklandia populnea	...	Pipli
32.	Buxus sempervirens	...	Box wood
33.	Calophyllum spp.	...	Poon
34.	Canarium euphyllum „ strictum	...	Dhup
35.	Carallia lucida ...	...	Carallia
36.	Carapa moluccensis	...	Pussur wood
37.	Careya arborea	...	Tummy wood
38.	Cassia Fistula ...	...	Indian Laburnum wood
39.	Castanopsis indica	...	Indian Sweet Chestnut wood
40.	Cedrela spp. ...	...	Toon
41.	Cedrus Deodara	...	Deodar
42.	Celtis australis ...	...	Nettle wood
43.	Chickrassia tabularis	...	Chittagong wood
44.	Chloroxylon Swietenia	...	Satinwood
45.	Cinnamomum spp.	...	Cinnamon wood
46.	Cordia fragrantissima	...	Sandawa

47.	Cordia Macleodii	... Hadang
48.	Corylus spp. ..	. Indian Hazel
49.	Cullenia excelsa ...	... Karani
50.	Cupressus torulosa	... Himalayan Cypress
51.	Dalbergia cultrata	... Burmese Blackwood
52.	,, latifolia	... Bombay Blackwood
53.	,, Oliveri	... Tamalan
54.	,, Sissoo	... Sissoo
55.	Dichopsis elliptica	... Palay
56.	,, polyantha	. Tali
57.	Dillenia pentagyna	... Dillenia
58.	Diospyros oocarpa	... Andaman Marble wood
59.	Diospyros spp. ...	... Ebony
60.	Dipterocarpus alatus	
	,, costatus	
	,, Griffithii	... Gurjun
	,, incanus	
	,, turbinatus	
61.	,, indicus	... Black Dammar
62.	,, pilosus	... Hollong
63.	,, tuberculatus	... Eng. wood
64.	Duabanga sonneratioides	... Lampati
65.	Dysoxylum glandulosum	... White Cedar
	,, malabaricum	
66.	Elæodendron glaucum	... Alan
67.	Eriolæna Candollei	... Salmon wood
68.	Erythrina indica	... Widget wood
69.	Eugenia spp. ...	... Jaman wood
70.	Fagræa fragrans	... Anan
71.	Fraxinus floribunda	... Himalayan Ash
72.	Garcinia spp. ...	... Gamboge wood
73.	Garuga pinnata ...	... Garuga
74.	Gluta travancorica	... Tinnevelly Redwood
75.	Gmelina arborea ...	... Gumhar
76.	Grewia tiliæfolia	... Dhaman
77.	Hardwickia binata	... Anjan

78.	Hardwickia pinnata	...	Payan
79.	Hemicyclia spp. ...	...	Malabar Box wood
80.	*Heritiera spp.* ...	...	Sundri
81.	Heterophragma adenophyllum		Karen wood
82.	Holoptelea integrifolia	...	Indian Elm
83.	*Homalium tomentosum*	...	Monkey slip wood
84.	Hopea odorata	...	Thingan
85.	„ parviflora	...	Bogey wood
86.	Hymenodictyon excelsum	...	Kuthan
87.	Juglans regia ...	...	Walnut
88.	Juniperus macropoda	...	Indian Juniper
89.	Lagerstrœmia Flos-Reginæ	...	Jarul
90.	„ hypoleuca	...	Andaman Pyinma
91.	„ lanceolata	...	Benteak
92.	„ parviflora	...	Lendi
93.	„ tomentosa	...	Leza
94.	Lophopetalum Wightianum	...	Banati
95.	Machilus spp. ...	...	Ladder wood
96.	Magnolia spp. ...	...	Magnolia wood
97.	Mangifera spp. ...	...	Mango wood
98.	Melanorrhœa usitata	...	Burmese lacquer wood
99.	Melia Azedarach...	...	Persian Lilac
100.	„ composita ...	...	Malabar Nim wood
101.	Mesua ferrea ...	...	Gangaw
102.	Michelia Champaca	...	Champak
103.	Millettia pendula...	...	Thinwin
104.	Mimusops Elengi „ littoralis	...	Bullet wood
105.	Morus spp. ...	...	Indian Mulberry
106.	Murraya exotica ...	...	Chinese Box wood
107.	Ochrocarpus longifolius	...	Wundi
108.	Odina Wodier ...	...	Wodier
109.	Olea ferruginea ...	...	Indian Olive
110.	Ougenia dalbergioides	...	Sandan
111.	Parashorea stellata	...	Tavoy wood
112.	Parishia insignis ...	...	Red Dhup

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113.	Pentace burmanica	...	Thitka
114.	Pentacme suavis ...	...	Burmese Sal
115.	Picea Morinda ...	...	Himalayan Spruce
116.	Pinus excelsa ...	...	Blue Pine
117.	" Gerardiana ...	...	Chilgoza Pine
118.	" longifolia ...	...	Chir Pine
119.	Pistacia spp. ...	...	Pistachio wood
120.	Planchonia andamanica	...	Red Bombway
121.	Platanus orientalis	...	Eastern Plane
122.	Podocarpus spp. ...	...	Indian Yellow wood
123.	Polyalthia cerasoides	...	Reel wood
124.	Populus euphratica	...	Indian Poplar
125.	Protium serratum (Bursera serrata)	...	Saranda wood
126.	Pterocarpus dalbergioides	...	Andaman Padauk
127.	" macrocarpus	...	Burma Padauk
128.	" Marsupium	...	Kino wood
129.	" santalinus	...	Red Sanders
130.	Salix spp. ...	...	Indian Willow
131.	Santalum album ...	...	Sandalwood
132.	Schima Wallichii ...	...	Needle wood
133.	Schleichera trijuga	...	Kosum
134.	Shorea obtusa ...	...	Burmese Sal
135.	" robusta ...	...	Sal
136.	Soymida febrifuga	...	Soymida
137.	Stephegyne diversifolia	...	Binga
138.	" parvifolia	...	Mundi wood
139.	Stereospermum chelonoides	...	Padri wood
140.	Taxus baccata ...	...	Yew
141.	Tectona grandis ...	...	Teak
142.	Terminalia bialata	...	White Chuglam
143.	" Chebula	...	Myrabolan wood
144.	" Manii ...	...	Black Chuglam
145.	" myriocarpa	...	Panisaj
146.	" paniculata	...	Kindal
147.	" procera (Catappa)	...	White Bombway

148.	Terminalia tomentosa	...	Rock Bark
149.	Tetrameles nudiflora	...	Baing
150.	Vateria indica ...	...	White Dammar
151.	Vatica lanceæfolia „ Scaphula	...	Mascal wood
152.	Vitex altissima ...	...	Milla
153.	„ glabrata ...	...	Yoma wood
154.	Xylia dolabriformis	...	Pinkado
155.	„ xylocarpa ...	...	Irul

THE CALORIFIC VALUE OF SOME BOMBAY AND BURMA TIMBERS.

BY T. P. GHOSE, ASSISTANT TO FOREST CHEMIST.

In previous communications from this laboratory (Puran Singh Forest Bulletin No. 1., Ind. Forester, XL, 1914, 97), the *calorific powers of a number of Indian timbers were published.* Recently eight specimens of timber from the Divisional Forest Officer, Belgaum, and six specimens from the Divisional Forest Officer, Myaungmya, Bassein, Burma, were received and below the results of the determination of their calorific powers are tabulated as they may be of use to other Forest Officers :—

No.	Name of species.	Vernacular name.	Moisture per cent.	Ash per cent.	Calorific power (calculated on wood dried at 100°C).	
					Calories.	B.T.U.
1	Cordia Myxa ...	Bhokari ...	7·89	10·0	2,604	4,687
2	Bauhinia variegata...	Kanchan ...	10·16	6·1	4,013	7,223
3	Trema orientalis ...	Kanambada	8·7	4·6	2,940	5,292
4	*Ficus tuberculata* ...	*Omber* ...	8·0	4·6	3,092	5,566
5	Butea frondosa ...	Phanaswada	9·2	4·2	3,046	5,483
6	Hymenodictyon obovathum.	Bhoga ...	7·2	1·8	4,250	7,650
7	Zizyphus xylopyra...	Godachi ...	8·1	4·0	3,261	5,870
8	Polyalthia cerasoides	Ooh ...	7·6	2·3	4,808	8,654
9	Bruguiera gymnorhiza	Byu-u-talon	10·9	0·8	4,793	8,627
10	Ceriops Roxburghiana.	Madama ...	11·0	1·6	5,250	9,450
11	Cynometra ramiflora	Myinga ...	8·2	1·9	4,515	8,127
12	Excæcaria Agallocha	Thayaw ...	9·6	1·6	4,413	7,943
13	Heritiera minor ...	Kanazo ...	10·9	2·5	4,740	8,532
14	Rhizophora mucronata	Byu-chidauk	11·4	1·6	4,800	8,640

REVIEWS AND EXTRACTS.

AFFORESTATION IN THE U. P.

The Annual Report of Afforestation in the U. P. for the nine months ending 31st March last is a record of steady progress in the extension of afforestation work in the Etawah and adjoining districts. A commencement has now been made in the Agra District and enquiries are also being instituted regarding the possibility of extending the work to similar lands in other districts. The total area of land at present taken up aggregates 27,639 acres of which 6,512 have been afforested. The average cost per acre for the year's work is stated to be Rs. 76·3. Compared with the work of previous years this is not excessive bearing in mind increased wages, upkeep of cattle, etc. The operations have now been systematised and a steady rate of progress at a stable rate per acre should follow.

The afforestation operations commenced in 1913 and already over two square miles have been afforested.

It has been our good fortune recently to pay a visit to Etawah. The first impression is the almost hopeless condition of the locality—land broken up by denudation into an inextricable confusion of ravines and at present supporting only a semi-desert scrub. It required optimists to tackle such a problem. The solution was soon seen to lie in the conservation of the soil moisture and soil aeration. These are achieved by ploughing up or breaking up by hand the indurated surface layers. Ploughing requires a special plough and is real hard work. The magnificent bullocks are just able to draw the plough and no more. The soil is then ridged and planting or sowing is done on the finely prepared soil of the ridges. A recent development is the growing of cotton between the lines of ridges. This has the effect of suppressing weed growth and also promises to yield a handsome return, which will serve to reduce the cost of formation.

Babul exceeding 4′ in height at the end of the first year and shisham of 50′ in the 1913-14 plantations indicate the possibilities of the locality. The most striking feature however is the total change in the character of the surface soil in the oldest fully-stocked plantations, which is now of a friable nature and already shows a complete change in texture and consistency.

The work must however not be taken as universally successful. There have been failures and set-backs chiefly due to frost but a careful selection of species is reducing failures.

This afforestation work has attracted attention outside the United Provinces. Landholders and others from the Punjab and Indian States have toured in the locality and have been favourably impressed with the possibility of turning their own barren lands to similar use. A visit to this afforestation work is well worth undertaking and we can guarantee that every one paying such a visit will come away deeply impressed with the results achieved and the possibilities of converting other lands now a wilderness to a profitable purpose by similar sustained effort.

WHAT WILL INDIA DO WITH HER FOREST RESOURCES.

The following article by Mr. C. S. Martin, Consulting Forest Engineer, is reprinted from "East and West" for September 1921. We have heard at various times practically all the constructive suggestions made by the author but we have not hitherto struck the note sounded by Mr. Martin in his appeal to the legislatures to create opportunities for India's young men, expand her trade and increase her industries. Clearly we must organise in all directions and from below as well as from above. The employment of expert advisers must inevitably result in expansion of staff and of our activities as a whole, and we fear that it will be much more difficult to convince our financiers that this general expansion is justifiable than the members of our legislatures. We look anxiously for a practical scheme for financing our developments as without this

the expansion which we eagerly look forward to will not materialise :—

WHAT WILL INDIA DO WITH HER FOREST RESOURCES.

Before taking up India's specific problems in connection with forest products it will be necessary to make a short survey of the present world situation in regard to timber supply and demand, as this general situation has a very marked effect on the economic situation which has arisen in India since 1914.

The largest exporters of lumber at the present time are the United States and Canada. Japan is rapidly increasing her outturn and will eventually control the Far Eastern markets. Norway and Sweden have been marketing practically their full timber surplus for many years. Finland has large reserves yet to draw upon. Barring Austria and Russia on account of the political and financial chaos in those countries we have now named the principal timber-exporting countries of the world.

Africa and South America have very large timber reserves but their development has scarcely begun. Russia and Siberia have also very large timbered areas but it will be years before any systematic exploitation can be undertaken there.

The United States is cutting nearly six times as much timbe as her forests are growing each year and the people are just waking up to the disastrous consequences which will ensue if such an indefensible policy is continued. Restrictive laws are before Congress at this writing. Some of them will surely pass, backed both by public sentiment and by the lumbermen who realise that the conservation of timber resources is as much to their benefit as to that of the general public. Canada is taking note of other countries' mistakes and will not permit her cut to exceed the forest possibility.

II.—India's place in the general scheme.

Now let us look at the part India takes in the general scheme.

At the present time this country is only realising on about 10 per cent. of the value of the annual product of her forests. The

amount of timber grown annually would permit her to become a large exporter of lumber with the resulting benefit to her commercial position. There is a real world demand for dependable supplies of all sorts of wood products at good prices.

Yet, India imports Swedish pine, box shooks, boxes and general structural lumber. Her railways are bringing in 1,500,000 treated fir sleepers for experimental use this year from British Columbia and the States, while she has forests of her own, rotting within 40 miles of some of these same railways! A ship-load of lumber is now on its way from Puget Sound to Calcutta while Indian hill forests burn and are wasted to a greater extent than the wasteful American lumberman ever dreamed of. Egypt imports 8,000,000 sleepers from Canada. Why not from India, she has the forests and needs the money! Egypt asks for cedar squares from the States—we have the finest cedar in the world here in our deodar forests.

Why? If India can treble her forest revenue, needs exports to stabilise exchange, desires industrial development to protect her people from famine in years of poor crops, should she not take advantage of this opportunity?

The answer as to how this may be done can be given in three words: EDUCATION, ORGANISATION, TRANSPORTATION.

III.—What may be done and how accomplished.

The remedy lies entirely in the hands of Indians acting through their Legislative Councils and Assemblies. They have in this question one of the greatest opportunities ever given to a self-governing country to show a far-sighted statesmanship. India can make herself a model for other countries to follow, as her forests have been wisely conserved and improved through the splendid, unselfish work of the Indian Forest Service. Under continued forest management the yield of her forests will steadily increase. Concentrated working and large returns will make possible more intensive management showing greater results even than have been attained in the past.

If India can afford money to pay freights on lumber across the Pacific, if she can put profits into the pockets of the Swedish

lumberman, she can well afford the capital needed to place her own forests on a modern commercial basis. Every rupee wisely spent in this way will return threefold eventually.

Forests are not a long-time, low-return investment as are canals and railways. With no taxes to pay on timber lands and operating in Government-owned forests a sound forest exploitation scheme should return from 25 per cent. to 100 per cent. profit. This is not a wild statement. It is a prediction based on many going operations where taxes and stumpage are important items listed under 'cost of doing business' Government operations here need not consider these items, as the standing timber is not taxed and has cost Government little except the cost of past management which has, in most cases, been more than returned from the products of the forests.

In order to roughly outline the steps necessary to approach this problem in a systematic and comprehensive manner I will take the three main points in order :—

1. EDUCATION.—

(*a*) *General.*—First we must put the facts before all educated Indians ; must lay our cards on the table; say " Gentlemen, this is what we have done. Here are the things we are now trying to accomplish " and " this is what may be done with your support."

Accounts of all items of interest concerning the forests and forest work should be given to the press from time to time.

Committees from the Legislative Assemblies should be shown the work under way through personal inspection. This has been done in Madras for a number of years and is now being taken up in the *United Provinces.*

(*b*) *Higher Education.*—Exploitation and utilisation of forest products are as much a part of forestry as regeneration and management and require as high a type of man, educated as a specialist in these branches.

In the Pacific Norwest of the United States where 60 per cent. of the population is directly dependent on lumbering for their livelihood, economic necessity compelled the installation of Forest Engineering Schools in all of the principal Universities. These

courses run for four years and confer a degree of F. E. or Forest Engineer on graduates.

Canada is now starting several such schools but it will be a number of years before she can begin to turn out trained men.

India should be the third nation to take up this important branch of education.

The training of forest engineers for India in the States and Canada is both expensive and unsatisfactory. To insure our development of exploitation being a success we must train Indians of ability as well as Europeans. The proper place to train these men is at Dehra Dun. This will require support from all the provinces.

I suggest a first year in general forestry such as is now given at Dehra Dun. This first year will be essential in preparing a base work of forestry principles on which sound specialisation can be built. This will be followed by a two years' special course in forest engineering, supplemented by as much field work as may be practicable, and concluded by a six months' tour in Formosa, the Philippines, Borneo, and the Dutch East Indies, where modern logging methods are being used, in order to study the adaptations necessary in such methods to fit in with tropical conditions and labour. Later as we develop modern methods in India, this trip may be altered to one covering the more important Indian operations.

(*c*) *Higher Subordinate Staff.*—The training of men for these positions can be carried out in existing provincial and ranger schools. A two years' course will be sufficient. These courses will be supplemented by lectures and talks by trained field men from the different provinces. There should also be a Central Bureau which could secure and distribute educational moving pictures illustrating all phases of forest work. All types of logging machinery could be shown at work and studied, each film being sent around to all the different schools.

(*d*) *Lower Subordinate Staff.*—These men can be trained on the job and by being assigned to special operations for short periods to become familiar with the methods employed.

2. ORGANISATION.—

Here at the start we will have to depend on a few experts from the States and Canada, for the simple reason that nowhere else in the world have men been trained and had practical experience in these lines.

In four or five years some of the men now coming to India from training in the States will have had enough practical experience to supplant these outside experts. Later, as locally trained men become proficient the whole organisation will become self-supporting as to personnel.

(a) Organisation must be made an integral part of the Imperial Forest Service.—As we are building for the future, and a permanent future, the whole organisation must be placed on a stable basis.

Utilisation being as much a part of forestry as silviculture the only real solution of the problem is to make the new exploitation and utilisation service an integral part of the present Imperial Forest Service, offering the men who take up this branch of the work a permanent and assured future.

Unless we do this we will not get the right type of men. Without the right type of men the work cannot be successfully carried on.

(b) General Provincial Organisation.—Each province where important exploitation works are being carried on will require a trained forest engineer with a number of years of practical experience to co-ordinate and supervise all the work going on in that province. Such men will have to be recruited on a temporary basis from the States or Canada until local men can be trained, with the exception of those provinces which already have a Chief Forest Engineer whose Indian experience and training balances the lack of specialised training in forest engineering.

Without such an experienced man at the head, to attempt to inaugurate new methods and build up a new organisation of men with no practical experience or knowledge of the country would simply be to invite failure and waste money. It must be remembered that in every instance the cost of this new staff is debited as

a cost of doing business and will be more than met by the increased outturn and surplus from the forests.

The whole scheme would be self-supporting from the start once it has been financially floated.

(2) The Chief Forest Engineer will have under him as many assistant forest engineers as are needed to carry on technical work in connection with the various exploitation schemes.

(3) In addition there should be a practical exploitation officer in charge of labour and outturn on each big unit under working.

(4) Under the exploitation officer will come exploitation assistants in charge of the various phases of the timber work such as felling and cross cutting, machine work, dragging, slide and drag path construction, etc.

(5) Under these men will come the gang foremen, head mistris, etc.

This all may seem like a very large organisation. It will, however, be employed only as the situation justifes and not all at once. These operations require this sort of close supervision in countries where a very high class of labour is obtainable. It is much more necessary in India where the work must be done by coolie labour. The coolie is a good workman up to the limits of his strength and intelligence if handled properly and treated fairly. But he must be supervised by men who understand him and his limitations.

3. TRANSPORTATION.—

This includes the extension of railways, the improvement of waterways for timber floating, the construction of slides and flumes, the organisation and installation of mechanical road transport, the cheapening of dragging methods, and the mechanical haulage of logs to a central point whence they may be sent on to depôts by some of the above-mentioned methods of transport.

All this is necessary because :—

(1) Enough transport is not now available to bring t h outturn of the forests to market.

(2) Enough labour cannot be secured to carry on necessary forest work without the help of machinery.

(3) Machine methods are cheaper.

The reason why you have forests within 30 to 40 miles of railways going to waste while you import sleepers from America, is that such forest material cannot be transported by coolies and bullocks over rough ground to the railways. With mechanical transport in the form of ships you are bringing like material nearly 9,000 miles. Give us a comparatively small amount of capital to lay down our transpor schemes and we can drive all foreign lumber off the market and can undersell them in Australia, Mesopotamia and Egypt; can place our valuable woods on the London and even New York markets at a very satisfactory profit.

This all means an increase in Indian industries. Much of our logging material and supplies we can manufacture here. The by-product of our saw-mills will enable match factories, and all sorts of minor wood working industries to be established, besides the large industrial development that the saw-mills will create in themselves.

IV.—Saw-mills.

A great part of this expansion of forest resources will not be possible unless we establish modern saw-mills to cut the logs into merchantable requirements.

With the hand-sawing methods which are so largely depended upon now the waste on material converted into lumber is from 50 per cent. to 80 per cent. This is left to rot and burn in the forests.

Given strategically located saw-mills all of the logs can be utilised, even the saw-dust. Much additional material can be marketed from the forest that otherwise could not be used at all on account of the high cost of hand-sawing and the scarcity of woods labour. These mills will give us lumber in an exportable form. They will largely increase railway traffic and form a very desirable type of freight.

By having our material cut in mills at central points we can afford to put in modern seasoning plants using steam from the saw-mill boilers. We can put in timber-treating plants so the lumber and sleepers can be chemically treated to preserve the wood against white-ants and against decay. This will enable us to use our less valuable woods for construction and sleepers and to sell the valuable species such as sal, pynkado, and deodar at high prices in export and home markets for special uses—(*vide The Egyptian Demand for Cedar Squares*).

V.—Development of Markets.

This is a matter which must be taken up in a big way by trained men from the Forest Department.

Samples of the valuable export woods must be kept on exhibition in London with full reports on their qualities and uses and details of the amount of such woods which can be furnished and at what prices.

Co-operating with the Research Laboratory at Dehra Dun full information as to the value and uses of Indian woods must be furnished to all manufacturers using wood, to constructing engineers, to governments and business associations in Australia, Mesopotamia and Egypt or any other potential markets. Also information as to qualities and prices.

Free samples of timber should be furnished on request for tests as to their availability. Daily almost, new uses are being found for Indian timbers. Woods hitherto unknown and unused are being found to be of great value. I will cite examples of this in discussing the developments of the past six years in respect to Indian timbers.

VI.—Current Indications of Present Economic Trend.

One would merit the criticism of being a visionary in pointing the possibilities ahead of India's forest development were he not amply backed by current advances being made here and under similar conditions.

The best Indian example is in the Andaman developments. Prior to 1914 there was no demand of Andaman timbers other

than Padauk and incidentally very small quantities of the scattered, known, very hard woods such as satin-wood, marble-wood, etc., these latter not being found in quantities large enough to pay for commercial extraction.

The war came with its endless demands and economic upsets. Departmental working was undertaken in the Andamans. A mill was established and Andaman woods were placed on the London and Calcutta markets in sufficient quantities to make them desirable commercially.

Now there is a demand for 15 different Andaman species in excess of the supply and at prices that under very conservative estimates will yield 30 per cent. net per annum on the investment needed to put the proposition on a commercial basis. Many other species will be in demand as soon as we can put them on the market in sufficient quantities to insure a regular supply to users.

The Philippines have many timbers similar to Indian timbers. Three large private concerns are now lumbering there using modern methods of extraction and milling. Their progress has been so satisfactory that they are constantly expanding and adding new facilities and markets.

The Japanese have developed a similar logging and milling enterprise in Formosa.

In the Dutch East Indies in a situation very like that in the Andamans, a Dutch company has been working for years. They use logging railways, skidders and have a large band saw-mill. Late reports say they are adding a second saw-mill and are increasing the log outturn.

Another company is operating in Borneo.

The signs of the times are everywhere apparent, the question is only to what extent India will take advantage of her opportunities.

VII.—Conclusion.

In India we have the Andamans with 2,200 square miles of magnificent forests.

We have thousands of square miles of productive coniferous forest in the Himalayas.

We have 19,000 square miles of forest in Madras, not to mention the wide tracts of forest lands in other provinces and in Burma.

Last year India exported a little over 50,000 tons of timber, mostly teak. That figure can be eventually exported from the Andamans alone! There is an abundance of fir and spruce to supply Egypt's 8,000,000 sleepers, to supply our own railways, to make wood cheap enough to be more widely used all over India. We can supply derricks for the Mespot oil-fields, 60,000 boxes for her date crop.

This means opportunities for India's young men, an expansion of her trade, an increase in her industries.

The whole matter is up to you, gentlemen, who now administer the country. To make these things possible you must give us money to inaugurate these schemes and intelligent support in forest development. In return a very large increase in revenue will be available in a few years and the country as a whole will benefit in many ways.

It would be perhaps the best opportunity India will have in the immediate future to show her capability of joining the most advanced nations of the world in the development of one of the greatest of natural resources.

THE "SPIKE" DISEASE OF SANDAL.

The following extracts from a paper on 'Mosaic Diseases of Plants' printed in West Indies, Bulletin No. XVIII, are of interest in connexion with the 'spike' disease of sandal. Those wishing to read the paper in full will find it reproduced in the Agricultural Journal of India, Vol. XVI, Part 4, November 1921.

Referring to the study of plant pathology the paper says:—

"Later, many other diseases were shown to be similarly caused by bacteria. There still, however, remained a number of affections which could not be attributed to any known organism. These have been classed under the term 'physiological diseases.' A critical examination of our knowledge as to these diseases

reveals the fact.........that they are a heterogenous collection of phenomena, agreeing in nothing except that their cause is not known. The further conception that the diseased condition is the manifestation of some functional or metabolic disturbance is purely an assumption. Certain diseases, at one time thought to be 'physiological,' have since been proved to be connected with parasitic organisms."

"While no recognisable organism has been found, the symptoms are entirely those of attack by a parasite, and there is a strong body of belief inclining to the opinion that there may be involved an ultra-microscopic parasite—a conception that has already been adopted in animal pathology.

Mosaic diseases provide an exact parallel with certain animal diseases, such as small-pox and infantile paralysis, which are considered as being caused by ultra-microscopic organisms. They are more or less readily communicable. and the sap of diseased plants can be filtered through ordinary bacteria-proof filters without losing its infectious properties. Furthermore the disease is frequently transmitted to healthy plants through the agency of insects, such as aphides, which infect them.

The best known and most thoroughly investigated of the mosaics is that of tobacco. Tobacco mosaic manifests itself in various ways. The plant may show partial or complete chlorosis, or may be entirely dwarfed. In other cases, the leaves show curling, dwarfing, blistering and distortion, or a mottling with different shades of green. The flowers may also be distorted, and in *Nicotiana tabacum*, the normally pink flowers become entirely bleached or blotched with white.

The closest search has failed to reveal any recognisable organism to which the disease could be attributed, yet it has been shown to be highly contagious.

The virus from tobacco will also produce a similar disease in certain other solanaceous plants, as tomato and petunia. It has been shown that *Physalis alkelengi* may act as a carrier of the mosaic of *Solanaceæ*, without itself showing any symptoms of disease. This possibility of 'carriers' has to be borne in mind

when dealing with supposedly immune varieties of plants susceptible to mosaic. . . . . .

Within recent years, it has been shown that the disease of potatoes known as 'leaf-curl,' 'curly-dwarf,' or 'mosaic' is also of an infectious nature, and is caused by a virus in which no visible organism can be detected. Although infection of potato can be obtained from tomato by grafting, it has not been possible to transmit the disease from tobacco. Artificial transmission of leaf-curl is not so easy as in the case of tobacco mosaic, but may be effected by certain methods as by rubbing together leaves of diseased and healthy plants. It has been found also that infection may take place in nature by root contact. . . . .

Mosaic or leaf-curl has been found also to be transmitted by certain aphides. . . . . .

Insect transmission of the disease has been perhaps most thoroughly investigated in the case of curly-top of sugar-beet. The disease was shown . . to be communicated by the beet leaf-hopper. The question has been tested experimentally by numerous investigators, and it has been shown conclusively that the leaf-hoppers are not in themselves infective, but only become so after feeding on diseased plants. . . . . To induce the disease in a healthy beet, it is sufficient to confine one virulent leaf-hopper for five minutes on a leaf of the plant. Of great importance in connexion with the perpetuation of the disease, from season to season, is the fact . . . . that various wild plants are susceptible to the virus, and, further, that leaf-hoppers may retain their virulence for a long time, even when feeding on non-infected plants. Carsner considers it highly probable that overwintering of the virus is accomplished by these two factors."

"The case of spinach blight is interesting. The disease is carried by aphides . . the infectious principle may be transmitted from the parent aphides to their offspring, through a period sufficiently long to tide over the interval between successive spinach crops. A similar inheritance of the virus is known in the case of some animal diseases."

There are a certain number of other obscure diseases of plants, which while not agreeing with the true mosaics in their symptoms, yet appear to be transmissible and caused by an infectious virus. Among these may be mentioned such diseases as 'peach yellows,' 'sereh disease' of sugar-cane, 'spike' disease of sandal, etc. In most of these cases the information available is scanty.

With regard to the nature of the virus causing these various diseases, the theory first advocated, and still held by many workers, is that the infective principle is an enzyme . . . . the great objection to the enzyme theory appears to be the difficulty of explaining how such a catalyst would originate. If one adopts this view, it is necessary to assume that at some period an enzyme, or a substance capable of activating enzymes, has arisen in the plant *de novo*, possibly in consequence of some disturbance in metabolism. Were this the case it would be possible to induce the disease at any time, by engendering such a disturbance in the activities of the plant cell. As far as experiments have gone at present, however, we know of no means of producing mosaic disease in a healthy plant, except by infection from another diseased plant.

On the other hand, none of the properties of the virus so far investigated is entirely inconsistent with the theory of the presence of an organism. In particular, the fact that the virus remains active, even in extreme dilution, and is capable of increasing indefinitely, within the tissues of the host, points to the action of a living organism rather than a chemical substance.

"*Until comparatively recently, the conception of such ultra*-microscopic organisms remained entirely theoretical. The work of Lohnis and Smith in 1916, however, on the life-cycles of bacteria, opened up entirely new possibilities in connexion with this as well as other pathological problems. Lohnis and Smith found that bacteria may enter an amorphous 'symplastic' stage, in which condition parasitic species might not be readily distinguishable from the protoplasm of the host cell in which they occur. urthermore, they observed the formation of filterable 'gonidia,'

which may produce new bacteria directly, or after having entered the 'symplastic' stage. In view of these facts, the possibility that eventually many of the infectious filterable viruses will be proved to contain living organisms is brought appreciably nearer."

C. E. C. FISCHER, I.F.S.

SILVICULTURE AND UTILISATION CONFERENCES, DEHRA DUN, JANUARY 1922.

Photo.-Mech. Dept. Thomason College, Roorkee.

Top row (left to right).	J. E. Macpherson, W. T. Hall, J. L. Simonsen, W. Raitt, T. S. Pipe, C. V. Sweet, H. C. B. Jollye, A. D. Blascheck, R. D. Richmond, C. C. Wilson.
Second row from top (left to right).	H. R. Blanford, W. C. Chipp, L. N. Seaman, M. P. Bhola, M. Cameron, G. E. Marjoribanks, J. W. Nicholson, C. Harlow, R. S. Hole, W. A. Robertson, A. Rodger, E. R. Stevens, H. Trotter.
Seated on chairs, (left to right).	R. S. Pearson, F. F. R. Channer, F. A. Leete, H. G. Billson, P. H. Clutterbuck, W. F. Perrée, J. W. A. Grieve, J. R. McGiffert.
Seated on ground (left to right).	L. S. Teague, J. S. Owden, F. Canning, S. F. Hopwood, R. N. Parker, C. F. C. Beeson, S. H. Howard, C. S. Martin.

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FORESTRY IN THE BRITISH ISLES.
PART I.

The first annual report of the Forestry Commissioners for the year ending 30th September 1920 gives a clear historical account of the evolution of British State Forestry. This account is divided into four periods. The first, termed the period of destruction, dates from the relaxation of the Norman laws in the 13th and 14th centuries to the end of the 18th century. Forest denudation without adequate replacement was characteristic of *this period and it may be noted that at the end of the 15th* century alarm was felt at the rapidity of denudation in the interests of smelting, cattle grazing, and sheep farming. The destruction by mankind was intensified by destructive gales which swept down the remaining forests. The second, described as the period of private enterprise, followed upon agricultural revival. A growing demand for ship building and interruptions of imports directed the attention of land-owners to planting on a large scale. Scientific and other bodies and in a measure Government aided

such private enterprise. The management of Crown forests was the subject of three separate enquiries but it is significant that the necessity for a national policy was not realised by Parliament or the general public. It must be admitted however that in spite of the absence of State organisation or State assistance in research or education it was to the solid achievement of private enterprise during this period that home-grown timber became so great an asset at the most critical period of submarine warfare during the war. The choice lay between imported food or imported timber and the country was fortunately able to supplement the supplies of timber in this emergency.

The third period was devoted to enquiry and extended over the 30 years ending in 1915. The spread of industrialism and resultant increase of imports, pressure from Arboricultural Societies, the establishment of forestry schools, the unselfish enthusiasm of the lecturers, and the reflex action of the young Indian Forest Service gradually drew attention to the shortcomings of the existing practice and did much to lay the foundations of sound silviculture. Departmental Committees and Royal Commissions followed in rapid succession. Constructive proposals were made but limited funds and the fact that imported timber was always available led to little actual achievement or public interest.

The fourth period was one of State action. Statistics had shown that (1) imports of timber had increased fivefold between 1850 and 1910; (2) the consumption per head in the same period had risen from 3½ cubic feet to nearly 11 cubic feet per annum; (3) the ratio of home to foreign timber had declined, and in 1914 amounted to barely 10 per cent. of the supply; (4) the price of imported timber had risen steadily during the thirty years before the war while the quality had declined. In 1913 the quantities of timber and grain imported were about equal and headed the list of imports. Together they absorbed about a quarter of the shipping that entered British ports. The Great War proved that the British nation must set its house in order and to its credit it must be said that no time was lost in taking effective measures. In July 1919 a Bill was introduced into

Parliament, passed through both Houses and received the Royal assent on 19th August 1919. On 29th November the Forestry Commissioners were appointed and at once took up their duties.

In justification of the somewhat lengthy historical abstract given above it may be pointed out that it contains a valuable object-lesson for India. In the process of evolution that must follow the spread of what we are pleased to call civilisation, experience proves that timber stands in the forefront of the necessities of life. It is not the case that metals replace timber in the process of social advancement; history shows that the consumption per capita rises with increased civilisation. India with its immense natural resources must eventually rank high among the nations, and at the present time when so much is heard of the unpopularity of forest laws and restrictions it would be well to pause and consider the experience of other countries. India is at present much in the position of Britain after the repeal of the Norman laws. The resultant feeling of liberty may well lead to the reconsideration of a policy that will, in the case of forestry, sacrifice the present for the future. Much is made of the restrictions to which the people have to submit in order to safeguard a sufficient area of forests for posterity. There will, however, be a rapid change in the economic condition of the people and an equally rapid improvement in the existing methods of agriculture and stock raising. Intensively managed pastures will replace the barren wastes which now constitute the village grazing grounds and in India, as elsewhere, it will be found that forests afford the poorest pasture and are therefore uneconomic. The increasing demand must and will be met by improved methods. The temporary expedient of removing all restrictions and thereby ruining the forests would eventually lead, as is now the case in the British Isles, to the resumption of reafforestation and restoration at great expense. The laws of evolution in this respect are inexorable.

(To be continued.)

NOTE ON THE DEATH OF CHIR (*PINUS LONGIFOLIA*) POLES IN THE ALMORA PLANTATIONS OF KUMAON.

BY H. G. CHAMPION, I.F.S.

Extensive dying off of the young pine plants resulting from sowings made since 1875 in the Almora plantations has been going on for several years, though the records are far from continuous; thus Stebbing writes of it as being in progress in 1908, ascribing it to the attacks of a weevil.* The writer first visited Almora in April 1916, and from that month onwards has continued to collect any information and to carry out various experiments, which might help to elucidate the question as to the primary cause of death. Marked trees have been under observation since the rains of 1918, and as a transfer has of necessity interrupted the continuity of the work—a continuity which unfortunately has not even approached what is really necessary for a satisfactory investigation—it is deemed advisable to place on record such data as have been collected and the deductions made from them.

Distribution of the Mortality.—It is very difficult to co-ordinate the physical factors of the several localities of high mortality, which latter may be specified briefly as follows :—

Baldhoti C. 7, 8.—Sowings commenced 1900 and 1909. Eastern aspect, shallow soil with shelf-like outcrops of schistose rocks; fairly heavy grass including the aromatic *Andropogon distans.*

Baldhoti C. 9, 10.—Sowings commenced 1910 and 1906. Northern aspect, soil of moderate depth and freshness over schistose rock ; fairly heavy grass ; moderate shrubby growth.

Sitoli C. 1, 2.—Sown in 1908. Northern aspect, soil of moderate to good depth over schistose rock, with heavy growth of shrubs. *Andropogon distans* absent.

Kalimath C. 3—5.—Sowings mainly in 1903—07. Southern aspect, graphitic schist with a good deal of outcrop ; soil shallow and dry on steep slopes, with heavy grass of which *Andropogon distans* forms an important proportion.

* Cf. Stebbing, "Indian Forest Insects," pp. 431—435.

Deolidanda, central strip.—Sowings mainly in 1905. The crest of a ridge on very shallow soil over massive granite.

Ghurari.—Generally similar to Deolidanda.

Age and Size of Trees.—It is very noticeable that in Baldhoti C1—6, a complete crop of plants has been obtained in the past (1875—1899) even on extremely poor areas with only an inch or two of soil over solid sheet rock. No mortality is to be observed among these trees, whereas recent attempts to stock adjoining similar inferior areas have regularly failed owing to the death of the young plants as soon as they commence to grow up in their third and following years. Contrasting with this tenacity of life among the older plants in Baldhoti, is the very serious mortality among well established poles now 13 years old and 1'—2' in girth in Sitoli C1, 2. Some few such large plants have died off in Kalimath but not elsewhere, the general rule being that the trees succumb when of a height from 1½' to about 4', especially on dry and shallow soils.

Extent of Mortality.—The following table giving the numbers of recently dead plants actually cut and removed in 1918-19 and 1920-21 years, shows that the matter is one of some import, especially in view of the fact that the figures certainly fall considerably short of the real loss. Only trees under 1' girth are included :—

Kalimath	... 1918-19	... 2,055	plants up to 1' girth.
	1920-21	... 930	" " "
Baldhoti	... 1918-19	... 48	" " "
	1920-21	... 722	" " "
Sitoli	... 1920-21	... 923	" " "
Chitai	... 1920-21	... 312	" " "

Of twelve poles 1'—2' in girth marked down in Sitoli* in 1918 when all had perfectly healthy crowns, only two now survive, whilst, as will be detailed below, of 100 such trees† in a compact

* Inspected on the following dates :—1st August 1918, 11th October 1918 19th May 1919, 21st September 1919, 1st August 1920, 29th May 1921, 20th June 1921, and 19th July 1921.

† Inspected on the following dates :—21st September 1919, 11th July 1920, 1st August 1920, 7th October 1920, 16th February 1921, 28th April 1921, 20th June 1921, and 19th July 1921.

block in almost the best grown part of this plantation, kept under observation since the rains of 1919, 25 have already died, and the death of 12 more before long can safely be predicted.* In Kalimath and Baldhoti Cpt.-10, the extremely unsatisfactory condition has been reached where the gaps caused by death at least equal the filling obtained by resowing; in the case of parts of Kalimath, the writer is of the opinion that they are now more open than when first he saw them.

Progress of Disease.—The slow response of the appearance of the crown to the development of disease is not only very striking, but also increases the difficulty in getting control work efficiently carried out. Perusal of the appended tabular record will show how long a period may, and usually does elapse between the first record of something being wrong, and the final death of the tree; in fact, three years is the probable normal period. During this time, the appearance of the crown remains absolutely normal even to careful examination, although removal of the bark may show that the cambium has been completely girdled for at least 12 months; even the date of the expansion of the buds, the height growth, and the length and denseness of the needles remain unaffected. Then suddenly, first the twigs lose their normal brittleness, then the bright tint of the foliage is lost and in a week or two the whole crown goes yellow and dry. There is however usually an external manifestation of the influences at work within the tree in the form of a more or less copious outflow of resin from the basal parts of the stem—generally over a zone from 6″ to 3½′ up. Such a flow seems ultimately to end in the death of the tree in all cases though tree No. XXIV still survives since 1918. There is a tendency for the inroads of disease to be concentrated in patches, but this is far from being exclusively the case.

Season of Death.—Trees with foliage recently gone off colour may be found at almost any time of the year, but there is an indication of a maximum in March-April, when the activity of the trees is renewed after the winter rest, and another in August which may correspond to maximum insect activity.

* Nos. 13, 19, and 57 have been reported to be dead since this note was written.

Possible Causes of Mortality.

I. *Physical Causes.*—Not a few apparently fully healthy trees have died during 1921 without any visible signs of injury whatever, and there is little doubt but that this is to be ascribed to the drought which has been sufficient to kill back to the ground all the *Prunus Puddum* and much of the *Quercus incana, Alnus* and *Myrica* in the plantations. In some *chir* trees only a few boughs have suffered, which then present a curious appearance at once recognised as abnormal.

II. *Fungi.* (1) *Peridermium complanatum, Barclay.*—This fungus was first described by Barclay in 1890.* He believed that the fructifications on the needles were due to the same fungus as were those on the bark, remarking that, "I have only once seen it on the stem (var. *corticola*)." This has been the custom for the allied species, *P pini*, Waller (= Coleosporium, spp.), though the only record of actual experimental work I have been able to trace with the limited facilities at my disposal is the old work of Wolff in 1872. Wolff found that inoculations of the æcidiospores of *P. pini, both from the leaves and young branches,* on the leaves of various species of *Senecio*, resulted in the production of *Coleosporium senecionis.* Plowright, writing in 1889, had been unable to repeat with success the experiment for the bark form, though not attaching too great significance to his failure†, and unfortunately I have not succeeded in obtaining access to his later publications.

The identity of the two sharply distinguished manifestations has never been demonstrated for the Indian species, and it is preferred to consider them as distinct till the contrary is proved, though for convenience they will be termed *f. acicola* and *f corticola.*

(*a*) *Forma acicola.*—This is extremely common, and may be found on trees of all sizes from the one season old seedling on the juvenile leaves, up to the crown of old trees, though especially abundant on the dense and bushy foliage of young

* Cf. also Dr. E. J Butler, "Indian Forester," 1905. p. 611 et seq

† Plowright's "A Monograph of the British Uredineæ and Ustilagineæ," 1889, pp. 249, 250.

trees. It is recorded by Barclay that in Simla there are two crops of æcidiospores, one in November, and the other, much more abundant, from February to May; the former is usually accompanied by the production of spermagonia scattered irregularly over the surface of the needles, whilst no spermagonia are produced with the latter. As far as is known, this is also the case in Kumaon. In May 1917, the cortex of three young plants was inoculated with spores from this *f. acicola*, in one case on unbroken bark, in the second on a clean cut to the cambium, and in the third a jagged wound exposing wood and bark. These plants were inspected at intervals for 1½ years, but, as anticipated, no results were obtained from this attempt at direct inoculation.

Despite its abundance, no apparent damage is done to the host tree by the needle fungus. Attempts to trace an alternate host have failed hitherto, and it need only be mentioned here that the similar *Peridermium pini acicola* has been shown to consist of a whole series of ocularly indistinguishable biological species,* each of which has exclusively its own alternate host for the uredo- and teleuto-stage, in which it is known under the generic name of *Coleosporium*. Thus the pine needle æcidia originating from teleutospores of *C. senecionis* are now more precisely known as *Peridermium oblongisporium*, whilst the many others with teleuto-stage on *Sonchus*, *Campanula*, *Tussilago*, *Inula*, *Melampyrum*, etc., each have their distinguishing name and separate identity.

(*b*) *Forma corticola*.—This fungus sends its orange æcidia through the crevices of the bark towards the end of the hot weather in May; on 29th April 1921 they were only just appearing and on 20th June 1921 they had mostly discharged the spores and bleached. Sometimes an æcidial cup, and rarely an undischarged æcidium, may be seen at other times of the year, but generally no trace can be found on trees known to be infested. The occurrence of the fungus is not of necessity accompanied by external bleeding, and no case has been noted where cankerous

* In 1839, Plowright had hardly begun this investigation, to which he only makes a brief reference in the work quoted.

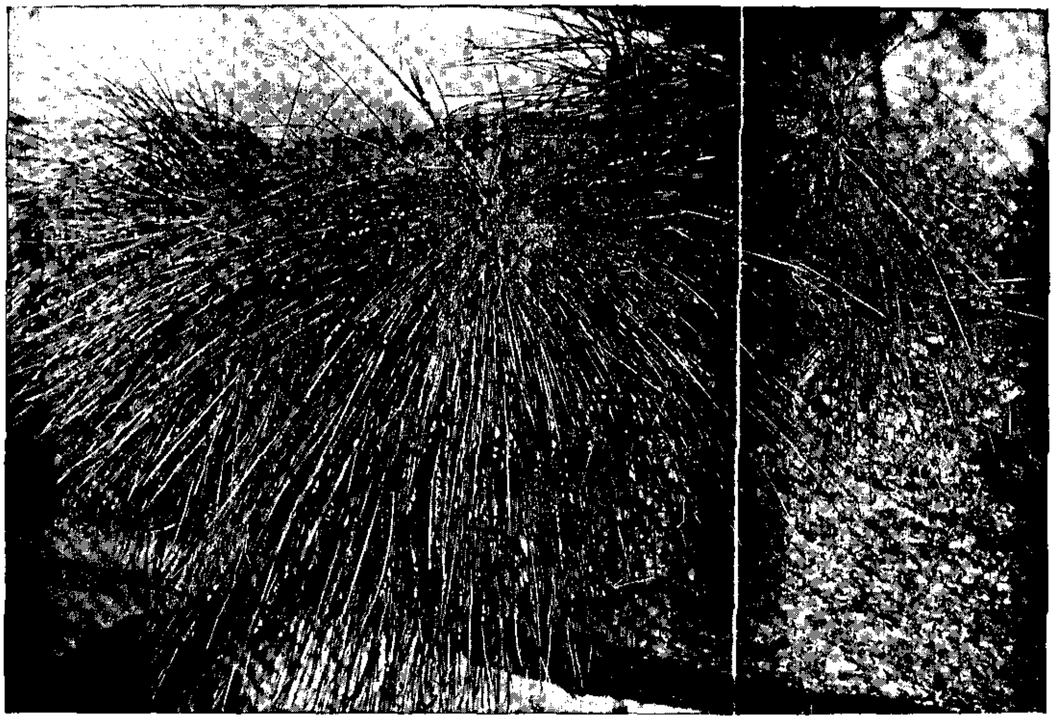


Photo. by H. G. Champion.

Fig. 1. *Peridermium complanatum acico'a.*

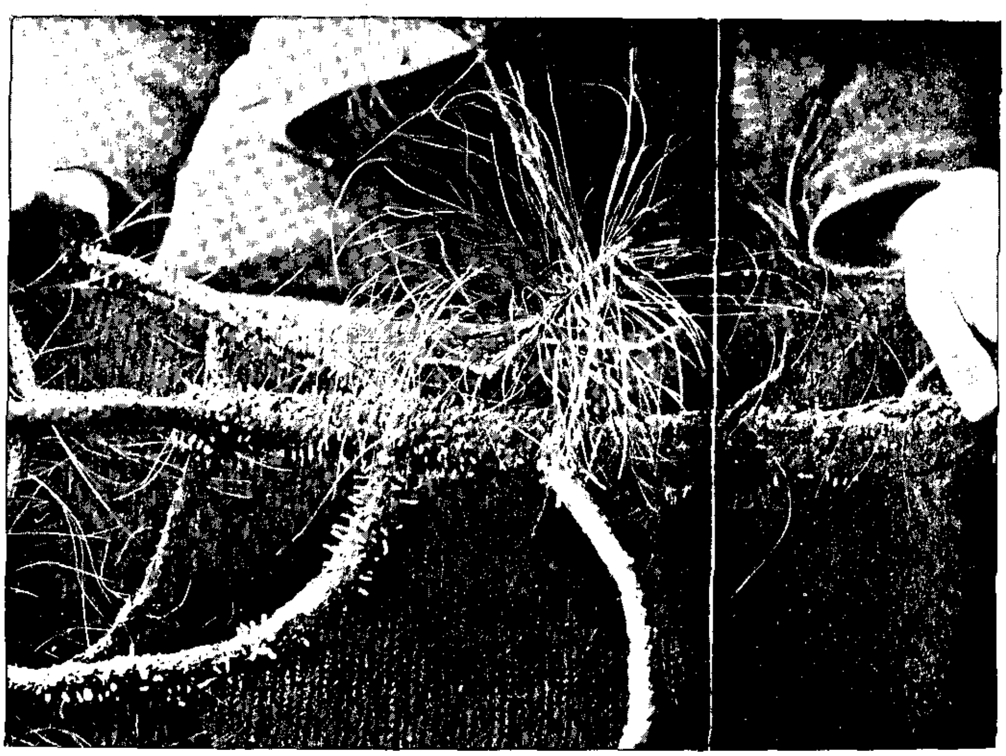


Photo.-Mech. Dept., Thomason College, Roorkee. Photo. by W. J. Lambert.

Fig. 2. *Peridermium complanatum corticola.*

swellings could be definitely and exclusively ascribed to the fungus. On the other hand a trickle of resin may be the first indication of an infestation and Mr. Hafiz Khan found, on examination of the cortical tissues below the origin of such a flow, mycelia which probably belong to this fungus.

F. corticola is but rarely seen on natural regeneration and then usually on poorly grown or unhealthy small trees. In the plantations, however, it may be really abundant and is especially so in the areas of high mortality. Thus in Kalimath C 4 on 100 ft. square, of 127 plants 2'—6' high, 77 showed the fructifications (all 127 had *f. acicola*), and of the 100 larger trees of the Sitoli plot, æcidia have been noted on 27. On 11 trees, of which six have subsequently died, the appearance of æcidia preceded any record of insect damage, being itself preceded by more or less resin flow in two cases.

Fructifications are very generally on the main trunk 6" to 3' from the ground, often limited to one side: they sometimes extend to the branches and rarely only one or two branches may become badly infested, and even swollen and cankered finally dying off without disease spreading to the rest of the tree (two cases noted).

A small experiment was made in May 1917 on eight small trees for direct inoculation of the æcidiospores from an infested tree on to the intact or injured bark of uninfested plants, but as anticipated no results were obtained.* Search for an alternative host has not been successful, but it may be suggested that *Cratægus* is sufficiently probable to be worth making the subject of inoculation experiments. In the event of failure with *Cratægus*, *Rosa moschata* might be tried. In the plantations other than these already mentioned, notes on the occurrence of this fungus have been made as follows :—

(1) *Bandanidevi.*—Not definitely recorded, but probably present. There is an unusual amount of the scale insect in this plantation (cf. infra).

* It may be noted that for all inoculation experiments with æcidiospores it is essential to use absolutely fresh material in a perfectly ripe condition, cf. Plowright, loc cit, foot of p. 107.

(2) *Chounsli.*—Searched for but not found.

(3) *Matena.*—Not recorded, but probably occurring.

(4) *Chitai.*—*Nil.*

(5) *Kapoli I.*—A few stems were found dead on 13th December 1920, in C1 and 3, apparently from fungus attack : mainly on poor soil.

(6) *Malla Manila.*—On 28th April 1918, seven trees were found to be infested with bark Peridermium, and all nearly dead. On 17th March 1920, 20 or more infested trees were noted, mostly small and not over-vigorous stems.

Talla Manila.—On 28th April 1918, five trees heavily infested but otherwise appearing healthy : a few examples were also found on 17th March 1920.

(7) *Chakargaon.*—Several dead trees were noted in C1 on 17th April 1918, with *Cryptorrynchus : Peridermium* was not seen. On 15th June 1920, bark fungus was found commonly in C1a, mainly on the branches rather than the main stem, whilst in C1b it was still more abundant, and some small bushy trees had apparently been killed by it. The north-east aspect of C2a was free of bark fungus and the south-west aspect, as also C2b, nearly so.

I have no trustworthy record of *Trametes pini* in Kumaon and there is certainly no indication that it has anything to do with the matter under discussion. The roots of a good many sickly and dying trees have been dug up and examined and almost invariably they are found to be perfectly healthy. The base of the stem for 6″ or so up from the ground is also very commonly free from insect attack until the tree is completely girdled higher up.

(*To be continued.*)

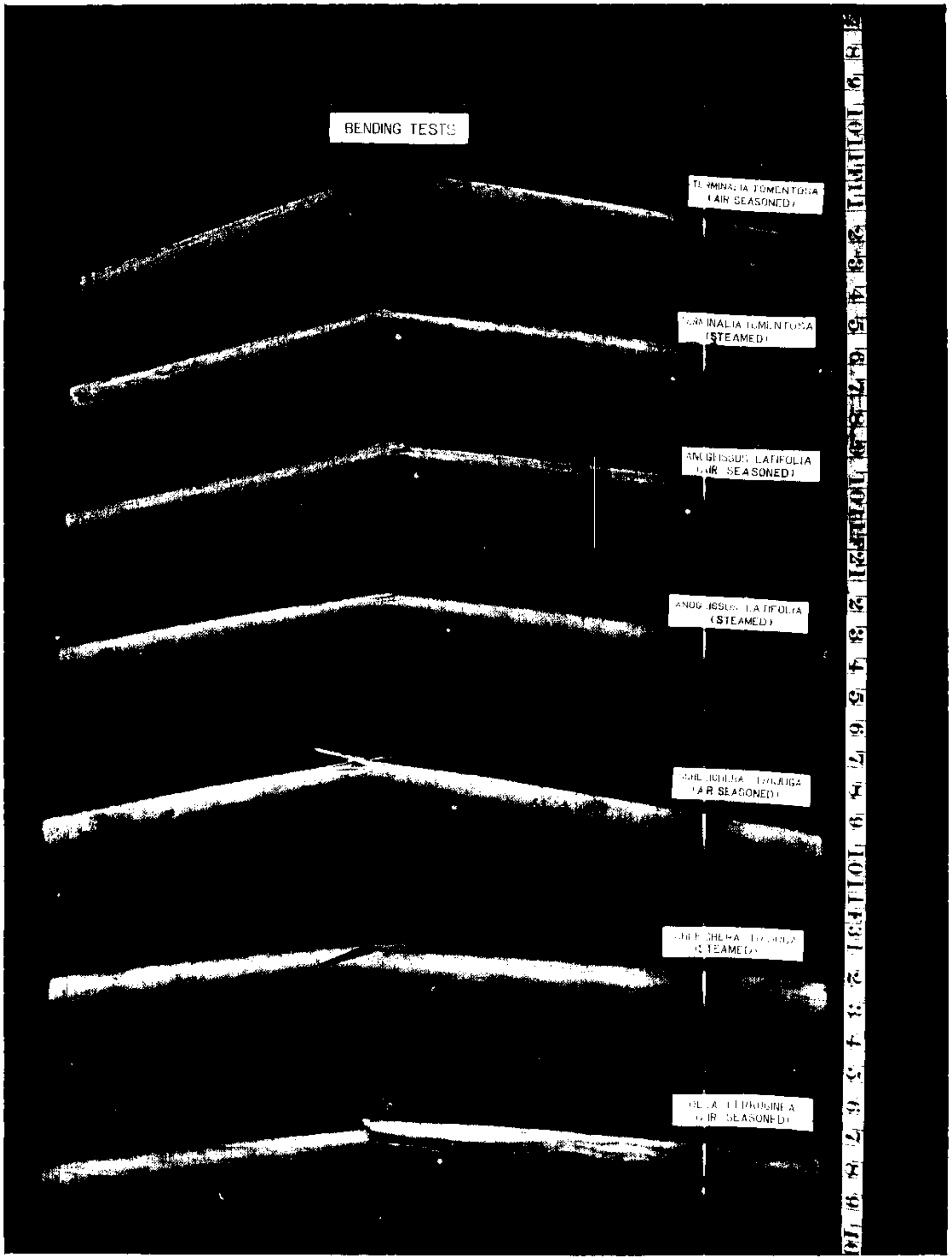


Photo.-Mech. Dept., Thomason College, Roorkee.

Characteristic failures of hammer shafts-Side surface.

THE SUITABILITY OF CERTAIN INDIAN WOODS FOR HAMMER HANDLES.

Introduction.

The tests hereinafter reported were undertaken at the request of the Utilisation Conservator for the United Provinces. Railway companies cite *Olea ferruginea* (Khwan, or Kau wood) as a suitable wood for hammer shafts, but were not prepared to accept *Anogeissus latifolia* (Dhaura) for that purpose. It was decided at the same time to investigate the relative merits of natural seasoning and of steam seasoning wood to be used for tool handles, and to test the other speciesm entioned below as possible competitors in this field.

Tests Employed.

Bending being the principal strains to which hammer shafts are subjected the woods have been tested by subjecting them to both static and impact bending. For this purpose the standard Olsen Universal Testing Machine of 30,000 lbs. capacity and the Hatt-Turner Impact Testing Machine were used. The speed of the former machine was adjusted, considering the cross section and distance between supports, to give the standard rate (0·0015 ins. per inch per minute), of strain in the extreme fibre of the handles tested.

Material.

Four species in all were tested and of these three were tested in both the air seasoned and steam seasoned conditions. Of the other, *Olea ferruginea*, no steam seasoned material was at the time available. The specimens were made up into standard 24 inch handles of about 1¼ inches by 13/16 inches section at their smallest part, and tested on a span of 19 inches, bringing the smallest section close to the centre of the span, where the load was applied.

Results.

The results of all tests of each kind have been averaged because, owing to the nature of wood, individual results may be

very misleading, and are here presented in tabular form. Table No. 1 records the actual average results obtained, Table No. 2 a percentage comparison between *Olea ferruginea* and the other species tested, and Table No. 3 presents the percentage comparison of strength between natural seasoned and steam seasoned material of the same species.

Explanation of Tables.

In all three tables strength up to elastic limit is shown in columns 1 and 2 for ordinary loading, and 11 and 12 for loads applied instantaneously; actual breaking loads are shown in columns 3, 4, 15 and 16; stiffness under a steady stress is shown in columns 5 and 6, and under sudden stresses in columns 13 and 14; finally toughness under steady stress if proportional to the results found in columns 7 and 8, and under instantaneous stresses to those found in columns 11, 12, 15 and 16. In order to make direct comparisons between the species examined all necessary corrections for differences in moisture content have been applied, and the properties of the other three species expressed directly as percentages of the corresponding properties of *Olea ferruginea*, (Table No. 2). In order to indicate also the effect, if any, of artificial seasoning, Table No. 3 has been prepared presenting the properties of the steam seasoned wood directly as a percentage of the corresponding properties of natural seasoned material of the same species.

Conclusions.

Of the species tested *Anogeissus latifolia* appears to be at least the equal of *Oleà ferruginea* for tool handles. It is not quite so stiff (columns 5, 6, 13 and 14 of Table No. 2), but is decidedly tougher under steadily applied loads (columns 7 and 8, Table No 2) and of about the same toughness when subjected to impact stresses (columns 11, 12, 15 and 16). *Schleichera trijuga* and *Terminalia tomentosa* are somewhat inferior to *Olea ferruginea*, for tool handles, falling somewhat below that wood in their ability to resist shock (columns 15 and 16). Under a steady load they are tougher, and they are not so stiff.

Table No. 3 shows plainly that the steam seasoning has no undesirable effect on material used for hammer shafts. Except the results for *Terminalia tomentosa* shown in columns 14 and 16 the variations are extremely small, and even these do not exceed possible variations among individual specimens of the same species.

Though the number of tests made was necessarily small the results strongly indicate the suitability of all four species for tool handles, and more especially *Anogeissus latifolia* and *Olea ferruginea*. The exact extent of this suitability, however, and the special uses for which each species is peculiarly fitted will not be thoroughly established till the woods have all been subjected to the regular routine tests under Project No. 1. When this work is completed it will not only furnish final reliable comparisons between these species, but will also definitely establish their relative strength, toughness and stiffness as compared with Ash, Hickory and other accepted tool handle woods.

TABLE No. 1.
Results of Tests on hammer handles.

Species of wood.	Static Bending.						Impact Bending.					
	Fibre stress at E. L. lbs. sq. in.		Fibre stress at Max. load lbs. sq. in.		Moisture content.		Fibre stress at E L. lbs. sq. in.		Ins. drop causing failure.		Moisture content per cent.	
	Air dry.	Kiln dry.	Air dry.	Kiln dry.	Air dry.	Kiln dry.	Air dry.	Kiln dry	Air dry.	Kiln dry.	Air dry.	Kiln dry.
	1		3	4	9	10	11	12	15	16	17	18
Anogeissus latifolia ...	10.591	11,050	20,737	19,787	12	12	32,402	38,579	8·2	9·3	12	12
Schleichera trijuga ...	8,445	10,635	17,259	17,910	12	12	35,007	34,061	8·0″	6·7	12	12
Terminalia tomentosa ...	9,230	11,388	18,014	16,428	2	12	31,312	25,102	8·0″	5 8	12	12
Olea ferruginea ..	7,742	...	21,151	...	12	...	34,672	...	9·3	...	12	...

Note.—The term" Air(dry " is used for natural seasoned, and" Kiln dry " for steam seasoned material.

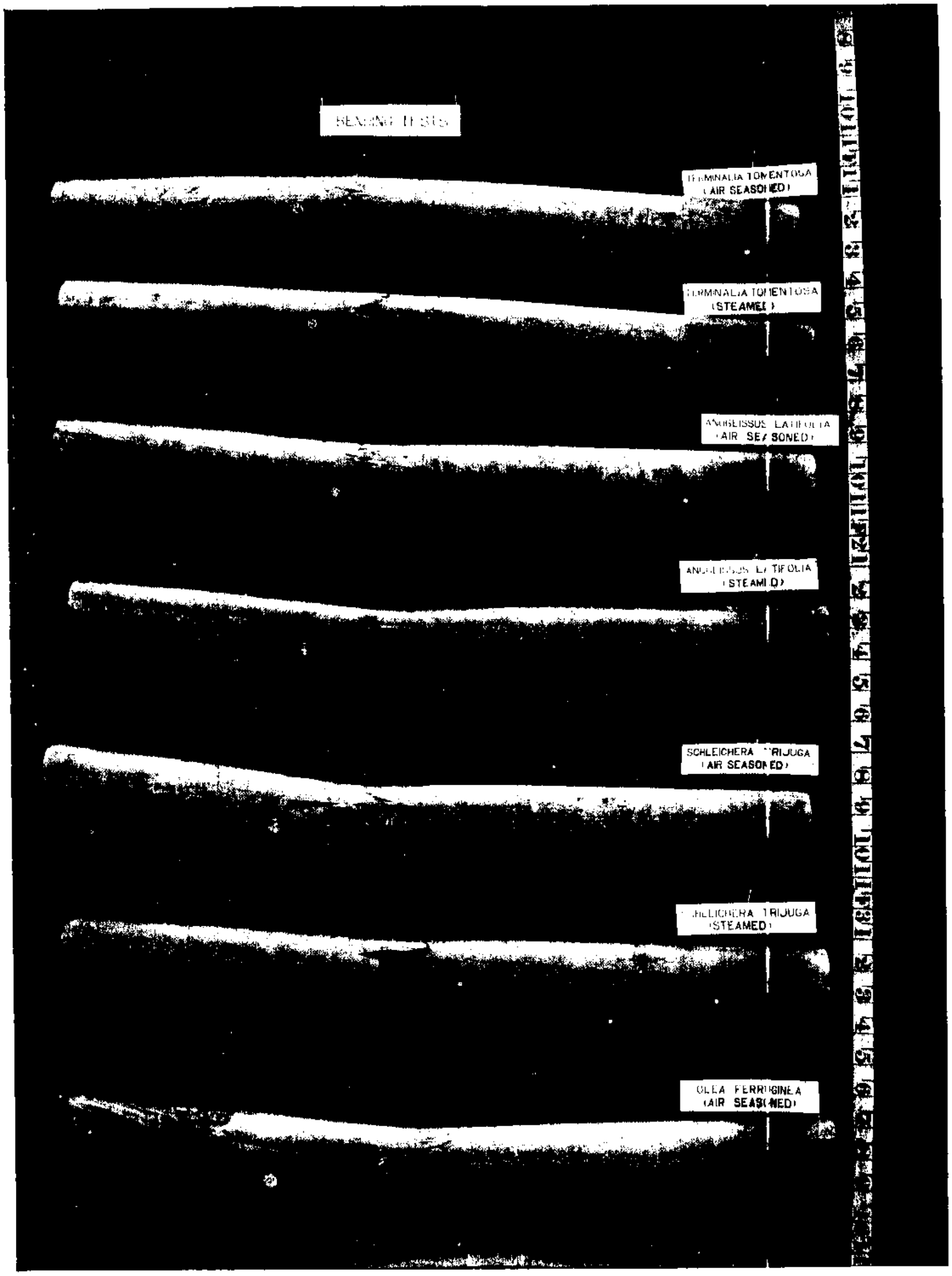


Photo.-Mech. Dept., Thomason College, Roorkee.

Characteristic failures of hammer shafts–Tension surface.

[To face Table No. 1.

TABLE No. 2.

Comparative results of tests on hammer handles, taking Olea ferruginea to be 100%.

(Moisture content 12% of weight of dry wood.)

Species of wood.	Static Bending.						Work to E. L.		Impact Bending.					
	Fibre stress at elasitcity limit		Fibre stress Max. load.		Modulus of elasticity.				Fibre stress at E. L.		Modulus of elasticity.		Ins. drop causing complete failure.	
	Air dry.	Kiln dry.	Air dry.	Kiln dry.	Air dry.	Kiln dry.	Air dry.	Kiln dry.	Air dry.	Kiln dry.	Air dry.	Kiln dry.	Air dry.	Kiln dry.
	1	2	3	4	5	6	7	8	11	12	13	14	15	16
Anogeissus latifolia ...	137	143	98	94	93	87	197	219	93	111	75	70	88	100
Schleichera trijuga ...	109	137	82	85	84	76	141	240	101	98	75	94	86	72
Terminalia tomentosa ...	119	147	85	78	85	93	162	233	90	72	79	57	86	62
Olea ferruginea ...	100	...	100	...	100	..	100		100	...	100	...	100	...

Note.—The term "Air dry" is used for natural seasoned, and "Kiln dry" for steam seasoned material.

TABLE No. 3.

Ratios of the results of tests on natural seasoned and steam seasoned specimens of hammer handles.

(Taking air dry = 100 per cent.)

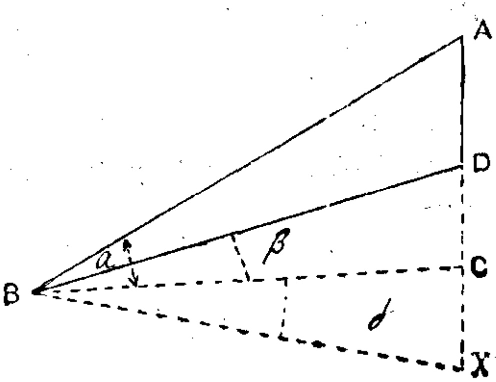
Species of wood.	Static Bending.					Impact Bending.			
	2	4	6	8	10	12	14	16	18
	Fibre stress at E. L.	Fibre stress at Max. load.	M. of E.	Work to E. L.	Moisture content.	Fibre stress at E. L.	M. of E.	Ins. drop causing complete failure.	Moisture content.
Schleichera trijuga.	126	104	91	170	100	101	127	81	92
Terminalia tomentosa.	116	88	106	133	109	80	72	73	100
Olea ferruginea.	...	...	...	...	...	...	...	...	...
Anogeissus *latifolia*.	104	95	94	111	100	119	93	113	100

CORRECTION IN "TABLES FOR USE WITH BRANDIS' HYPSOMETER." *

Ranger Digendra Mohan Ghosh of Assam has discovered an error in the Case III, pages iii to v, of these tables and has compiled a supplementary set of tables reproduced here for use in Case III in addition to the book tables.

They have been carefully checked at Dehra Dun. Ranger Digendra Mohan Ghosh does not explain exactly where Messrs. Manson and Haines are at fault.

The diagram in Case III is as below :—



In this example $\angle\alpha = 38°$, $\angle\beta = 20°$ and BD = 70 ft. For clarity I have produced AC to X making CX = CD and therefore $\angle\gamma = \angle\beta$ and BX = BD.

Their rule is as follows: Read off from the tables the height with the upper $\angle 38°$ and lower $\angle 20°$ and base 70 ft. This gives 75·33 ft. and is the height of AX,

Then read off for upper angle 38° and lower $\angle 0°$ and base 70 ft. This gives 54·69 and is supposed to be the height of AC.

But this is wrong. It will be found if the tables are examined that under all upper angles the figures given under lower angle

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* "Tables for use with Brandis' Hypsometer for measuring the height of trees, etc.," by Messrs F. B. Manson and H. H. Haines.

O° are simply the tangent of the upper angle multiplied by the base. Now the height AC = BC tan ∠38°. The height read as AC is 70 X tan ∠38° which is correctly 54·69 *but* BC is not 70 ft. The base we have measured is BD and BC is not known and Messrs. Manson and Haines' table really says that AC = BD tan α which is incorrect. Ranger Digendra Mohan Ghosh shows the error very simply by assuming that ∠α = ∠β = 30° and base = 70 ft. which obviously means the height of the tree is nothing. According to Messrs. Manson and Haines' tables however it becomes

Height with lower angle 30° = 70.00
" " " " O° = 40.41
Difference = 29·59

Height of tree required = 10·82 ft. which is absurd.

In order to use Manson and Haines' tables for Case III the supplementary table printed herewith must be used in addition and the rule is

Case III.—The observer's eye is on a lower level than the base of the tree.

Deduct twice the height with upper angle O° and lower angle β (supplementary tables) from the height with upper angle α and lower angle (Messrs. Manson and Haines' tables). The difference is the height of the tree.

Example :— Let α = 38°, β = 20° and BD = 70 ft.
Height with upper angle 38° and lower angle 20° = 75·33
" " " O° " " 20° = 23 94
Twice 23·94 = 47·88
Difference 75·33—47·88 = 27·45 ft.

The height of the tree in Case III is 27·45 ft. and not 34·05 ft. as given in Messrs. Manson and Haines' tables.

S. HOWARD.

SUPPLEMENTARY TABLES.

Upper angle 0°.

Base.	0°	5°	10°	15°	20°	25°	30°
1	0·00	0·09	0·17	0·26	0·34	0·42	0·50
2	0·00	0·17	0·34	0·52	0·68	0·84	1·00
3	0·00	0·26	0·52	0·78	1·03	1·27	1·50
4	0·00	0·35	0·69	1·04	1·37	1·69	2·00
5	0·00	0·44	0·87	1·30	1·71	2·11	2·50
6	0·00	0·52	1·04	1·55	2·05	2·53	3·00
7	0·00	0·61	1·21	1·81	2·39	2·95	3·50
8	0·00	0·70	1·38	2·07	2·73	3·38	4·00
9	0·00	0·78	1·56	2·33	3·07	3·80	4·50
10	0·00	0·87	1·73	2·59	3·42	4·22	5·00
11	0·00	0·96	1·90	2·85	3·76	4·64	5·50
12	0·00	1·04	2·07	3·11	4·10	5·06	6·00
13	0·00	1·13	2·25	3·37	4·45	5·49	6·50
14	0·00	1·22	2·42	3·63	4·79	5·91	7·00
15	0·00	1·31	2·60	3·89	5·13	6·33	7·50
16	0·00	1·39	2·77	4·14	5·47	6·75	8·00
17	0·00	1·48	2·94	4·40	5·81	7·13	8·50
18	0·00	1·57	3·11	4·66	6·15	7·60	9·00
19	0·00	1·65	3·29	4·92	6·49	8·02	9·50
20	0·00	1·74	3·46	5·18	6·84	8·44	10·00
21	0·00	1·83	3·63	5·44	7·17	8·86	10·50
22	0·00	1·91	3·80	5·70	7·51	9·28	11·00
23	0·00	2·00	3·98	5·96	7·86	9·71	11·50
24	0·00	2·09	4·15	6·22	8·20	10·13	12·00
25	0·00	2·18	4·33	6·48	8·54	10·55	12·50
26	0·00	2·26	4·50	6·73	8·88	10·97	13·00
27	0·00	2·35	4·67	6·99	9·22	11·39	13·50
28	0·00	2·44	4·84	7·25	9·56	11·81	14·00
29	0·00	2·52	5·02	7·51	9·90	12·24	14·50
30	0·00	2·61	5·19	7·77	10·26	12·66	15·00
31	0·00	2·70	5·36	8·03	10·59	13·08	15·50
32	0·00	2·78	5·53	8·29	10·93	13·50	16·00
33	0·00	2·87	5·71	8·55	11·28	13·93	16·50
34	0·00	2·96	5·88	8·81	11·62	14·35	17·00
35	0·00	3·05	6·06	9·07	11·96	14·77	17·50
36	0·00	3·13	6·23	9·32	12·30	15·19	18·00
37	0·00	3·22	6·40	9·58	12·64	15·61	18·50
38	0·00	3·31	6·57	9·84	12·98	16·04	19·00
39	0·00	3·39	6·75	10·10	13·32	16·46	19·50
40	0·00	3·48	6·92	10·36	13·68	16·88	20·00

SUPPLEMENTARY TABLES—*contd.*

Upper angle 0°.

Base.	0°	5°	10°	15°	20°	25°	30°
41	0.00	3.57	7.09	10.62	14.01	17.30	20.50
42	0.00	3.65	7.26	10.88	14.35	17.72	21.00
43	0.00	3.74	7.44	11.14	14.70	18.15	21.50
44	0.00	3.83	7.61	11.40	15.05	18.57	22.00
45	0.00	3.92	7.79	11.66	15.39	18.99	22.50
46	0.00	4.00	7.96	11.91	15.73	19.41	23.00
47	0.00	4.09	8.13	12.17	16.07	19.83	23.50
48	0.00	4.18	8.30	12.43	16.41	20.26	24.00
49	0.00	4.26	8.48	12.69	16.75	20.68	24.50
50	0.00	4.35	8.65	12.95	17.10	21.10	25.00
51	0.00	4.44	8.82	13.21	17.44	21.52	25.50
52	0.00	4.52	8.99	13.47	17.78	21.94	26.00
53	0.00	4.61	9.17	13.73	18.13	22.37	26.50
54	0.00	4.70	9.34	[illegible]	18.47	22.79	27.00
55	0.00	4.79	9.52	14.25	18.81	23.21	27.50
56	0.00	4.87	9.69	14.50	19.15	23.63	28.00
57	0.00	4.96	9.86	14.76	19.49	24.05	28.50
58	0.00	5.05	10.03	15.02	19.83	24.48	29.00
59	0.00	5.13	10.21	15.28	20.17	24.90	29.50
60	0.00	5.22	10.38	15.54	20.52	25.32	30.00
61	0.00	5.31	10.55	15.80	20.86	25.74	30.50
62	0.00	5.39	10.72	16.06	21.20	26.16	31.00
63	0.00	5.48	10.90	16.32	21.55	26.59	31.50
64	0.00	5.57	11.07	16.58	21.89	27.01	32.00
65	0.00	5.66	11.25	16.84	22.23	27.43	32.50
66	0.00	5.74	11.42	17.09	22.57	27.85	33.00
67	0.00	5.83	11.59	17.35	22.91	28.27	33.50
68	0.00	5.92	11.76	17.61	23.25	28.70	34.00
69	0.00	6.00	11.94	17.87	23.59	29.12	34.50
70	0.00	6.09	12.11	18.13	23.94	29.54	35.00
71	0.00	6.18	12.28	18.39	24.28	29.96	35.50
72	0.00	6.26	12.45	18.65	24.62	30.38	36.00
73	0.00	6.35	12.63	18.91	24.97	30.81	36.50
74	0.00	6.44	12.80	19.17	25.31	31.23	37.00
75	0.00	6.53	12.98	19.43	25.65	31.65	37.50
76	0.00	6.61	13.15	19.68	25.99	32.07	38.00
77	0.00	6.70	13.32	19.94	26.33	32.49	38.50
78	0.00	6.79	13.49	20.20	26.67	32.92	39.00
79	0.00	6.87	13.67	20.46	27.01	33.34	39.50
80	0.00	6.96	13.84	20.72	27.36	33.76	40.00

SUPPLEMENTARY TABLES—*concld.*

Upper angle 0°.

Base.	0°	5°	10°	15°	20°	25°	30°
81	0·00	7·05	14·01	20·98	27·70	34·18	40·50
82	0·00	7·13	14·18	21·24	28·04	34·60	41·00
83	0·00	7·22	14·36	21·50	28·39	35·3	41·50
84	0·00	7·31	14·53	21·76	28·73	35·45	42·00
85	0·00	7·40	14·71	22·02	29·07	35·87	42·50
86	0·00	7·48	14·88	22·27	29·41	36·30	43·00
87	0·00	7·57	15·05	22·53	29·75	36·72	43·50
88	0·00	7·66	15·22	22·79	30·09	37·14	44·00
89	0·00	7·74	15·40	23·05	30·43	37·56	44·50
90	0·00	7·83	15·57	23·31	30·78	37·98	45·00
91	0·00	7·92	15·74	23·57	31·12	38·40	45·50
92	0·00	8·00	15·91	23·83	31·46	38·82	46·00
93	0·00	8·09	16·09	24·09	31·81	39·25	46·50
94	0·00	8·18	16·26	24·35	32·15	39·67	47·00
95	0·00	8·27	16·44	24·61	32·49	40·09	47·50
96	0·00	8·35	16·61	24·86	32·83	40·51	48·00
97	0·00	8·44	16·78	25·12	33·17	40·93	48·50
98	0·00	8·53	16·95	25·38	33·51	41·36	49·00
99	0·00	8·61	17·13	25·62	33·85	41·78	49·50
100	0·00	8·70	17·30	25·90	34·20	42·20	50·00

AN OPPORTUNE ACCIDENT.

It was a lonely sort of place. The village had been deserted for a long time and its site was now only traceable by an occasional gaunt roof-tree protruding from the all-conquering jungle. There were a couple of ruined pagodas smothered in vegetation, and near them the pongyi-kyaung, itself half in ruins, in which we were camped. Built throughout of teak, it had outlived the flimsy houses of the village and the greater part of its shingle roof was still intact. It was advisable, however, to tread delicately like Agag, for the floor would scarcely have been passed by the P. W. D. The ceiling and doorways had been carved with loving care and the posts had once been covered with gold leaf which was now peeling off in strips.

I was seated in the dusk on the ricketty open verandah, smoking the pipe of peace after the labours of the day, watching the shadows deepen and listening to the monotonous calls of those weird birds, heard but never seen, which always herald the approach of night in the jungle. Gradually I became aware of that smell abhorred of all others, the smell of a smoky lamp, and I summoned my servant to enquire the reason for this outrage, for the lighting of lamps is forbidden at this magic hour. My servant indignantly denied the imputation, and indeed I could see for myself that no lamps had been lighted. But the smell was there, none the less, and I asked him if he did not perceive it. No, he did not. Thinking my nose was playing me a trick, I took a short turn in what had once been the compound, but on again entering the kyaung the noisome smell once more saluted my nostrils. This was strange, but I thought no more of it and ordered lamps and dinner.

Shortly after sitting down to my meal, the familiar sound of gongs began to pulsate through the air, not clearly and distinctly, and yet not exactly as if from a distance. The sound seemed to emanate from the building in which I sat, but at the same time I could not locate it. I referred this phenomenon also to my servant. Did he hear the sound of gongs? No, he did not. Now the nearest pongyi-kyaung was at least ten miles distant and there was not a breath of wind. I began to feel uneasy. If two senses had already deceived me, might not a third? I began to glance furtively into the shadowy recesses of the building.

Dinner over, I sat inside, as it was somewhat chilly out on the verandah, and settled down to a book. I had not read far when the air became filled with the chant we are accustomed to hear from pongyi-kyaungs at nightfall. I heard the old pongyi intoning a sentence of the Law and then the piping treble of his small pupils as they repeated it after him. As before, I could not locate the sounds—they pervaded the air, as it were, but I knew the pongyi was in the room and that his scholars were all around me. I was surrounded by beings I could not see, and I understood then for the first time what it must mean to be blind.

I could hear the shuffling of their bare feet on the boards, a cough and an occasional whisper; I was in the midst of them and the chant dominated all, but there was nothing to be seen. If my sense of smell had deceived me to start with, and my sense of hearing were now deceiving me for the second time, I prayed to God that my sense of sight might not deceive me also. I became stiff with horror, unable to do anything but stare at my dog, who, with hackles erect, stalked about on his toes in a stiff, mechanical way, sniffing at legs which I could not see.

How long this lasted, I do not know, but eventually I became aware of the pungent smell of smoke. My senses were not deceived this time, for I could not only smell the smoke but see it. Hearing also proclaimed the fact that this was no delusion, for my servants were crying out that the building was on fire. A hurricane lamp had been upset in some straw and we were hard put to it to save my belongings. I slept that night in the open air and the following morning left behind me without regret the charred ruins of that haunted building.

At the village which formed my next halt I related my experience to the thugyi. "The thakin was indeed lucky," he said. "Some years ago a man from this village, overtaken by night, took refuge in that kyaung. He was subsequently found there stone dead, with his features twisted into a dreadful look o terror. Since then we have avoided the place and dislike passing it even in broad daylight." "But how," I asked, "do you suppose he came by his death?" "When I was a boy," the thugyi replied, "the kyaung was dacoited and the pongyi and a good many of his pupils were put to death. No pongyi has ever lived there since and the village itself was deserted a few years afterwards."

D. P. H.

Note —Pongyi = monk. Pongyi-kyaung = monastery. Thugyi = headman. Thakin = master.

THE EFFECT OF POISONING SANDAL SEEDS ON GERMINATION.

An experiment to find out the effect of poisoning sandal seeds with red-oxide of mercury and perchloride of mercury was started in April last in the compound of the rest-house at Panapakam with a view to ascertaining whether rats attacked poisoned seeds and whether poisoning affected germination. The results were as follows :—

On 8th April 1921, 600 good seeds were selected, 200 of which were soaked for 3 hours in a solution of red-oxide of mercury formed by mixing 10 grains with 2 oz. of water. The seeds were then taken out and spread on the ground with the exception of 20 which were sown in a pot. 200 other seeds were soaked in a concentrated solution of perchloride of mercury for 3 hours and taken out and spread on the ground, 20 being sown in another pot. The remaining 200 seeds were not in any way specially treated and of these latter 180 were spread on the ground and 20 were sown in a third pot. The pots were regularly watered. Till 3rd May 1921 nothing happened but I could not come to any conclusion therefrom because the fact that even unpoisoned seeds were not touched by rats or squirrels appeared to show that there was an absence of these animals just about there (compound of the Panapakam rest-house). All the three sets of seeds were then shifted to the Ranger's house at Chendragiri where rats were said to be plentiful. On examination of the seeds again on 27th May 1921, it was found that all the seeds had been eaten by rats but no germination was observed even till 4th June 1921 in any of the pots in which seeds had been sown.

A further experiment was tried in the Ranger's house using a more concentrated solution of each poison (perchloride of mercury being 1 in 30 and red-oxide 10 grains to one ounce of water). 120 seeds were soaked in each for 36 hours and then taken out and kept in zinc buckets. As a result of even this experiment it was found that all the seeds had been eaten up.

The seeds sown in pots did not however germinate even till 26th July 1921.

I think the experiment is interesting as showing that it is not easy to keep rats away from sandal seed. Of course I have no record to show if any of the depredating rodents died as a result of their feast, possibly some at least did but that does not affect the main points that the seeds were destroyed and that those sown did not germinate.

A. C. LITTLEWOOD,
Dist. Forest Officer,
Chittoor.

THE TRAVANCORE FOREST COLLEGE.

Travancore, on account of its wide differences of rainfall, of elevation, and of temperature, is well known as a country of fine forests containing an extraordinarily large number of trees, bamboos, etc. It is even supposed that in the earliest times the land was entirely covered with forests, from the fringe of the sea to the highest ridge of the Ghats. During 1817 to 1820, Messrs. Ward and Conner, who were employed in a survey of the country, reported that something in the shape of working timber down from the forests by Government agency was initiated. The Forest Department under Mr. U. V. Munro, the first Conservator, was formed some time after that period. For several years thereafter the officers appointed in the Department were not men of any specialised training in Forestry—there being no idea at that time that forests needed being looked after by trained men. The only functions that were demanded then of Forest Officers were some methodical and profitable manner of felling, removal and sale of timber. In 1059 M.E. (1883–4 A.D.), however, a Forest Commission was appointed to discuss the management of forests and to draw up suggestions for their better administration. The first officer with the benefit of a course of training at the Dehra Dun Forest School was appointed in the year 1890 and in 1892 another student was deputed at Government expense for training there. Since then, at short

intervals, batches of two and three students have been deputed to Dehra Dun until the opening of the Forest College at Coimbatore, when stipendiary students were deputed preferably to the latter institution on account of its nearness to Travancore and the similarity of the forests there to those we have here. But in both these institutions only two or three seats were available for Travancore students each year and this delayed the training of all the men in the Department who required training. This circumstance, together with the enhancement of fees and expenses at these distant centres, debarred the Department from deputing further batches of students, and though the idea of having a Forest School of its own for Travancore has been in the air for some years past, it was left to Mr. V. Raman Menon, the present indefatigable Conservator of Forests in Travancore, to formulate a workable scheme for starting a Forest College in Travancore itself which has recently been sanctioned by the enlightened Government under Dewan Bahadur T. Raghaviah Dewan of Travancore. The Travancore Forest College, now *a fait accompli*, was accordingly opened on Monday, the 1st Thulam 1097 = 17th October 1921, by Mr. V. Raman Menon, the Conservator, with 15 departmental subordinates, as students, and is being held in the fine building at Quilon which housed the Conservator's office prior to its transfer to the capital here. Mr. K. S. Narayana Iyengar, D.D.R., one of the Senior Assistant Conservators, has been appointed Principal of the College and Messrs. Srikanta Pillai, B.A., M.R. (Hons.) and Trivikraman Tampi, B.A., M.R., have been appointed as Senior and Junior Instructors respectively. The opening of this Forest College in Travancore will supply a long felt want and will enable the training at a much cheaper cost of at least 47 subordinates who require training, in the course of about four years, besides giving a similar forest training to a limited number of private students That this is a step in the right direction, no one can deny, for, as a result of the venture, better efficiency in working of the Department and the management of our valuable forests will be ensured.

TECTONA.

SILVICULTURAL NOTES.

It has been advanced that the presence of epicormic branches on sal is often a sign of suppression and some have added that placing the sal in a free position does not produce epicormic branches. The second contention appears to be incorrect. In 1917 an increment felling was made in a sal area in Gorakhpur and 40 trees left per acre. The trees had an average diameter of 9·7 inches and had formed their permanent crown. They were healthy with good crowns. When the plot was started the boles were absolutely clean with no epicormic branches. By 1921 practically every tree was covered with epicormic branches 3 ft. to 5 ft. long and up to about 1 inch in diameter. The crowns were still healthy.

* * * *

In the March number of the *Indian Forester* 1917, a note was given of a method for the artificial regeneration of shisham in grass-lands by planting out 6 ft. nursery plants with all the leaves stripped off. At the present time these plants are some 25 to 30 ft. high while plants put out in the usual way as small transplants are only just appearing above the grass. The method is apparently generally used now in Gorakhpur for afforesting these grass-lands, the roots being cut down to about 1½ ft. if too long.

* * * *

An examination of an experimental plot in Dehra Dun has again shown that coppice with standards is a poor system for sal. The plot has 52 standards to the acre of an average diameter of 9·4 inches in 1917. Far too many but with standards of that diameter still leaving plenty of space. The coppice was twelve years old. The numbered shoots of the coppice had an average diameter of 3·4 inches but many were left unnumbered. By 1921 (five growing seasons) the standards had increased 1 inch in diameter on the average. The unnumbered coppice stems only 0·6 inch and the numbered were the best. Every shoot over 2 inches has now been numbered and the average diameter at 17 years old is only 3·5 inches. Quite apart from the slow growth the whole plot shows obvious signs of suppression.

PROBATIONERS UNDER TRAINING.

Through the kindness of Mr. Caccia, Director of Forest Studies, Oxford, we are able to print the following list of probationers who are now being trained for the Indian Forest Service and will complete their course in October 1923 :—

At University of Oxford.

Anantanarayanan, N.
Baksi, G.
Basu, Bimala Prasanna.
Basu, Subodh Kumar.
Lakhpat Rai.
Mohan, Netar Parkash.
Nayar, M. Kesavanunni.
Raj Narain Brahmawar.
Raj Narayan Singh.
Ranganathan, C. R.
Rao, S. R.
Ray, Kiran Chandra.
Sahni, N. D. M.
Senchaudhuri, S.
Sengupta, Manundra Lall.
Singh, H. P.
Singh, G. S.
Singh, J. A.
Allah Baksh.
Khanna, Harish Chandra.
Sodhi, Harbhajan Singh.
Barnes, J. F. F.
Brasier-Creagh, G.
Burgess, F. G.
David, A. M.
Garnett, P. N. H.
Hopkins, A. C.
MacColl, K.
Mackereth, J.
Manning, D. E. B.
Meyrick-Jones, P.
Raynor, E. W.
Sandeman, R. F.
Stephens, J.
Tatham, W. H.
Tollemache, H. V.
Warwick, G. D.

At University of Cambridge.

Barker, G. N.
O'Brien-Smith, E. Q.
Osborne, W. H.
Pudden, H. H. C.
Ricketts, T. C. D.
Sayres, R. J.
Simmons, E. C.
Sunder Singh.

At University of Edinburgh.

Smith R. J.
Woods, G. W. M.

The list of probationers completing their course in October 1922 is the same as published in the *Indian Forester* for October 1921 excepting the addition of two new probationers, one Mr. F. W. Withers, Oxford, and one Mr. W. D. M. Warren, Edinburgh; while the name of Mr. E. Guillame has disappeared from the list of probationers at Edinburgh.

REVIEWS AND EXTRACTS.

THE BIHAR AND ORISSA FOREST ADMINISTRATION REPORT FOR THE YEAR 1920-21.

Bihar and Orissa seems to be one of the few provinces where the Forest Department still works in comparative obscurity, almost unheeded by the other services and the general public. Apparently a visit from an Inspector-General is required to bring to the notice of the Local Government some of the most urgent needs of the provinces in the development of its forests as the report is punctuated with that officer's comments. The small interest shown by the Local Government in its forest property and in the well-being of its forest officers is evidenced by the

poor revenue derived from such valuable forest produce as *sabai* grass and iron ore and by the insignificant sum of Rs. 28,220 spent in the whole circle on new buildings for the staff; this, too, when the circle includes some of the unhealthiest Divisions in India. To sell the grass for an annual royalty of Rs. 23,000 and the iron ore for Rs. 46,000 which includes surface and dead rents and fees as well as royalty, when the sources of both raw materials are less than two hundred miles from the manufacturing centres, seems unnecessarily generous to the lessees.

Surely the Forest Department is entitled to a more adequate compensation for the damage done to its property by the operations of these commercial enterprises. If so it could afford an annual sum for housing its staff somewhat larger than the cost of an average-sized residence in Patna.

To crown all it is now denied any compensation whatever since the Local Government has ordered that all revenue from mineral concessions is to be credited to Land Revenue. Forests, unlike minerals, are a growing and not a wasting asset. We trust this consideration will induce the Local Government to adopt a more generous policy in forest matters.

The output of timber from Singhbhum Division, which usually carries the whole circle on its broad shoulders, is this year lamentable. The figures given are for nine months only, but this cannot explain a drop of 45 per cent. in the outturn of the principal fellings. The deficit is ascribed to labour difficulty and severity of sleeper passing but the yield of the adjacent Porahat Division with exactly similar conditions is well sustained. The truth is, so long as the system of granting a virtual monopoly over nearly the whole of these sal forests to a company whose sole interest can only be the satisfaction of its shareholders so long will the department be kept out of its fair share of the profits.

In other respects good progress is being made. Seventy miles of new cart-roads and twelve miles of bridle-paths were constructed. The problem of fire-protection is still the cause of much uneasiness but, as in politics, healthy unrest is a good sign.

The department is beginning to realise that expenditure on protecting from fire hundreds of square miles of worthless forest is hardly a business proposition. Naturally there have been a good many fires like everywhere else in India, and the die-hards are attempting to revive special fire-protection in areas scarcely worth while, an inevitable reaction which will pass.

The eternal problem of sal regeneration is still being wrestled with and still without success. In Puri Division sal is choked by a heavy growth of evergreen species and bamboos. Burning has not proved very successful as the fire only kills back the very young evergreen growth. The Conservator suggests clearing the undergrowth and opening out the canopy.

In Singhbhum the introduction of sal by *taungya* cultivation was a failure as the area was not fenced, with the result that both crops and seedlings were destroyed by bison and sambhar, an event which might have been foreseen.

The casuarina plantations in Puri are going ahead, 418 acres more having been planted up during the year. The cost of formation amounted to only Rs. 13 per acre. The plantation is to be worked under a rotation of ten years and the produce is expected to fetch Rs. 100 per acre. The spacing of plants now decided on is ten feet by ten.

It is excellent news that the revision of the Singhbhum Working Plan has at last been undertaken by one of the ablest officers in the provincial cadre. We hope that with the silvicultural improvement of the crop will be considered the exploitation of these valuable forests by up-to-date methods since they are more favourably situated with regard to markets and communications than many others yielding a much greater revenue.

A revised working plan for the sal forests of the Porahat Division introducing for the first time a uniform system into the province was sanctioned by Government during the year. We trust that in this and in all other applications of the uniform system about to be introduced the importance of early thinnings will not be overlooked. A serious attempt to find a market for sal poles should be made by the Forest Department itself and not

left to private agency. As it is important for the department to remove the produce of thinnings for silvicultural reasons it can be satisfied with a smaller profit than is demanded by a trading company, which proves that the interests of the two are not, as is sometimes asserted, identical.

THE FOREST POCKET BOOK.

COMPILED IN THE RESEARCH CIRCLE, UNITED PROVINCES; 1921. P. 161.
(*Government Press, U. P. Price Rs. 2.*)

We have a tender regard for this modest little volume, partly due to its coming addressed to the *Hon'ble* Editor, which soft impeachment, however unexpected, we would be the last to deny, and partly to its merits as the long wanted forester's *vade mecum*. Of its form we shall have something to say later but first the contents claim our attention. "Notes on Sowing and Planting" appears to be a sub-title for the publication but this is not clear. The first twelve pages are devoted to general notes on plantations and following these half a dozen pages are devoted to each of the following species:—*Shorea robusta* (Sal), *Terminalia tomentosa* (Sain or Asna), *Dalbergia Sissu* (Sissu), *Bombax malabaricum* (Simal), *Adina cordifolia* (Haldu), *Holoptelia integrifolia* (Papri or Kanju), *Acacia Catechu* (Khair), *Anogeissus latifolia* (Bakli), *Acacia arabica* (Babul or Kikar), Eucalyptus, *Cedrus Libani* var. *Deodara* (Deodar), *Pinus excelsa* (Blue Pine or Kail), *Pinus longifolia* (Chir or Chil), and Bamboos, *Dendrocalamus strictus*.

After each species and at intervals throughout the book are four blank pages for notes which cannot fail to be very useful. Following the notes on species come tables of seed weights and germination percentages, a note on the importance of careful seed collection and storage, and an indication of possibly suitable species for different soils and localities.

A number of very useful tables form a considerable part of the book. These include a table of spacing per acre, of soil preparation per acre, of allowances for bark, single tree volume tables for sal, oak, deodar and *chir*, taper constants for sal, table

of log volumes, standard diameter classes, interest and present value tables and a few others. Resin tapping data for *chir* are given followed by a few pages of mensuration formulæ and constants while the book ends with the United Provinces shooting rules, in which by the way there is an amusing misprint. On page 147 we are told of certain privileged persons who are permitted to hunt, shoot and *hsh !*

As will be seen from the above the book is intended mainly for the United Provinces, but till the others publish pocket books for themselves, and as a model when they do so, the present publication has an all-round usefulness. Bengal has already her "Nursery Notes" in pocket form and though not so ambitious a production as the Forest Pocket Book, we hear it is proving invaluable and other provinces will no doubt follow their example before long.

As regards the form of the book we may perhaps be permitted a few suggestions, especially if a 1922 edition is contemplated. (From the prominent position given to the 1921 on the title-page we presume it is intended to be a yearly production but we may be wrong on this point.) We think the book might be considerably thinner with advantage, the bulkiness being due to the thick paper used by the U. P. Government Press and to the unnecessary thickness of the boards. Thinner paper and limp cloth covers of a waterproof material, the dye of which will not "run" in the rains, would we think be a considerable and appreciated improvement. It might also be suggested that the blank pages for notes should be numbered as at present they cause delay in turning up a reference.

We congratulate the Conservator of the Research Circle on the exceedingly useful compilation and recommend it as a model to other provinces which may be thinking of following suit.

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Sylva.—The annual publication of the Edinburgh University Forestry Society. No. 2, 1921.

The Editor and the Society are to be congratulated on this bright and breezy magazine which should well serve its purpose of

maintaining touch between past and present members, as well as of chronicling, mostly in humorous vein, the events of the University year. The value of such a journal in fostering the spirit of camaraderie and *esprit de corps* between the different forest services of the Empire cannot be overestimated and we gather from the notes on members' movements, facetiously entitled, "Where did that one go to, Erbert?" that the men from Edinburgh are well scattered over the globe, India, Burma, the Malay States, Nigeria, Uganda and the Gold Coast, each having absorbed its quota.

The magazine is well got up, its paper and printing being beyond reproach.

* * * *

Te Karere o Tane.—A Monthly Newsletter issued by the Personnel of the State Forest Service of New Zealand.

We have been favoured with a copy of the Xmas number of the Newsletter which, if it truly reflects the spirit of the New Zealand forest officer, shows we would have to go far to find a more optimistic service. The Editor in his "Message" says:—"There comes a time in all effort when, as the old saying has it 'the romance goes out of the job' and it is precisely at that moment that the Newsletter must be at hand to show that every man jack of us in the service is up against it." We hope the Newsletter will long continue to carry its words of cheer.

VISCOUNT NOVAR ON FORESTRY.

Viscount Novar, who is honorary president of the Edinburgh University Forestry Society, in the course of his presidential address, said that their forest records were indeed woeful reading. At home they had allowed the axe and the rabbit to work their will on their trees, and had done little beyond ornamental planting; abroad their race had exploited one great reserve of virgin forest after another, as Continent after Continent fell to them. They had treated timber as if it were a mineral to be worked out, consumed, and abandoned, instead of treating it like any other crop, to be carefully garnered and renewed. The

task before them now was to save the remnants of their timber area, and to regenerate wasted forests all over the world. But if they were to get at real grips with the situation they must have accurate information as to how much remained to them of those virgin forests. They must also compute what should be their yield during an ascertained period, and, secondly, they must decide whether the control of forestry should remain in the hands of politicians, hard-up Treasuries, Departments without competent advisers, or whether, as in India, Nigeria, and now here at home, they should have guardian angels in the shape of Forest Commissions, and Services armed with some equivalent to the flaming sword, to ward, off the two-footed and four-footed enemies.

Hand-in-hand with the planting of timber, steps must be taken to develop an inter-Imperial timber trade. Many of their commercial timbers had yet to be made known in the chief markets of the world. The trade also required to have accurate information as to cost of extraction and freight, for the richest timber area situated far from railhead, as was frequently the case overseas, was a less alluring proposition to the timber buyer than a thinner crop in proximity to rail or sea transport. It was to help to secure up-to-date information on all these points and to bring surmise within the realms of fact that the Empire Forestry Association had been founded. Knowledge was, as usual, the best basis for a great forward movement, and, in this case, the data they were seeking were scattered far and wide over the face of the globe—hence the necessity of creating such an organisation to centralise information, digest and compile facts, and make them easily available to all Governments, corporations, societies, and individuals interested in the growth and use of timber.

The question was how could afforestation be best carried out. The landowner was the chief planter but he was passing away as easily as his friends could wish and as rapidly as his enemies might desire. And, at any rate, an individual who was called on to pay out 25*s.* for every 20*s.* received was not likely

to be in a position to re-clothe their bare hillsides. Local authorities and owners were being stimulated to plant this winter by a bonus of £3 an acre. But this scheme being primarily desired for the relief of artisan unemployment was not necessarily the best for forestry or for local labour. It would have been better and simpler to give moderate but unrestricted grants towards the satisfactory restocking of forest lands, and to remit all taxation upon them for a while. That would have gone far to ensure that this urgent work would be done at least cost, in quickest time. Why it should be a wise policy to give a free grant of £4 to farmers for every acre of oats and impossible to give an unconditional one of £3 towards the restoration of an acre of forest, was perhaps rather a riddle of politics than of economics. If this had been done the number of those able to take advantage of the scheme would have been greater, those employed more numerous, and the silvicultural, and therefore the permanent result—better.

Meanwhile their chief planter was the new authority, the Forestry Commission, which promised well. It was thoroughly well staffed and organised. Its district officers afforded valuable assistance to private planters. It was creating wealth and a normal demand for skilled labour and supervision, thus succeeding in doing excellent work itself without in any way arresting or interfering with the work of individuals, whether owner or nurseryman, operating in the same sphere. In this respect the methods of this Commission appeared so far to be an improvement on those of many a board and department which, through overmeddling and by launching ill-considered schemes, had often discouraged individual activities, intimidated private enterprise, and failed to achieve its purpose. If, however, the Forestry Commission maintained its unbureaucratic character, if it continued in good hands, and had freedom to carry out agreed on forest plans—if its funds were adequate, and a guaranteed increase was ensured so that plans could be followed out through the years to come and brought to completion—then State forestry will be an assured success. But plantations with a rotation of 40 or 240 years

demanded a fixed policy and a fixed income. A skilled industry must be immune from interference by unskilled politicians. That immunity has been secured to the forests of France and Germany and should be possible in this country. The Forestry Commission should also be able to achieve good results in science and research, for which ample provision was being made at the new Imperial Institute of Technology and at the established laboratories, through which the work of University and technical college would be supplemented and extended to cover the whole Empire. Many of these activities originated, like the Empire Forestry Association, at the Imperial Forestry Conference, a notable turning point in their records. In closing, Viscount Novar addressed a few words to the students. He said that though he might not have painted their professional prospects in very rosy colours, yet he would congratulate them on entering upon a career of absorbing interest, whose working hours would be even happier than its hours of leisure, one that would keep them in close touch with Nature, and one in which, though they might not make a fortune for themselves, they would be adding many millions to the wealth of their country.

CORRESPONDENCE.

MR. BOURNE'S DISSERTATION UPON FOREST FINANCE.

SIR,—Although I hasten to write to you about the above I regret that it is to help disprove and not to help prove Mr. Bourne's theories. There are a number of obvious misprints, but it is the faulty finance which is really serious.

Mr. Bourne's main conclusions are :—

(1) To yield the highest net income in proportion to the capital invested a forest must be worked under the rotation of the highest income. (Para. 1.)

(2) That by the simple expedient of fixing a low rate of interest at the start astonishing financial results can be achieved in forestry, *e.g.*, 20 per cent, and even more. (Paras. 15, 16, 17, 18, etc.).

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MAY, 1922.

SOME C. P. REMINISCENCES.

BY A. W. BLUNT, I.F.S.

In the early nineties I was in the Bilaspur Division which at that time was, and probably still is, a very happy hunting ground for anyone with an inclination for big game shooting. Tigers were numerous and generally bold cattle lifters, while they had not been much hunted and consequently, as a rule, lay up by their kills and were easily driven. I was fortunate also in getting hold of a first-rate tiger shikari, an ex-police constable, Akbar Khan by name, generally known to my friends as A. K., who lived for tiger hunting and cared nothing for other game. He did occasionally arrange a miscellaneous beat when I had a party with me and when tiger prospects were poor, but he usually had strong pickets of kills tied out all round my camp if there was the remotest chance of a tiger, and strongly deprecated any random shooting I had often to insist on one side being left open as an outlet for my energies where I might walk abroad in the evening with a rifle or scatter gun for my amusement, as distinguished from his

business of tiger slaying. He was absolutely devoid of fear of a tiger and even when it was wounded was reckless to a degree. Often I remonstrated with him for rashness in approaching a tiger presumably dead, but quite possibly alive, as it had fallen out of sight among bushes and grass. He would reply, "Sahib, if you are with me I know you hold straight and will protect me." I blushingly would acknowledge the compliment to my shooting but would suggest that an occasion might arise when something might just go wrong and then where should we be. He would suggest by word or gesture, "Oh, rot!" and on the next occasion continue to behave in exactly the same reckless manner. For this reason and from his intense eagerness to go after every tiger in the district he was at times a wearing companion of the chase. I had sometimes to strike and refused to be made to sit up for problematical beasts which he asserted were dead snips, but which I had found in many night watches were almost invariably non-starters. Probably all my readers, and certainly all writers of tiger stories, can dilate on the *pros* and *cons* of sitting up, so I will refrain from doing so beyond expressing my opinion that it is a very overrated amusement, that the *cons* have it except under very favourable conditions, and that even then it is useless sitting up after dark. Nor do I propose in these reminiscences to offer any instructions on how to pursue tigers, as their habits and the correct way of laying out beats have been fully explained by many writers possessed of more facile pens than mine. I will merely record a few shikar episodes which may be of interest.

I was starting for a tour through the Lormi Range and A. K. as usual had gone a day or two ahead to tie out kills. On my arrival he told me that a big tiger had taken a kill and dragged it into a hill near Siutarai. He had arranged for beaters and I went out with him to pick a place to put up my machan. It was a long low hill covered with a dense growth of bamboo and dry jungle. A fairly certain line for the tiger to take was to the east where the end of the hill was steep and growth nearly pure bamboo. We couldn't find a tree on or near the line on the hillside in which a machan could be tied from which I could see

anything, as the bamboo tops obscured the ground in every direction. At last, being fairly confident in my shooting, I decided to try a low machan against a bamboo clump from which I could see under the bamboos and we tied it only some six feet from the ground in such a position that by cutting out two or three drooping culms I got a fair view along a narrow arched passage to my right which the tiger must cross when driven. After I had set out the stops and taken my seat, the beat began and came along with a considerable noise so as to move the tiger early. It had not come half way along the hill when I heard a pebble rattle on the slope above me and within a minute I saw a large tiger looming through the bamboos almost directly above me. He was moving very quietly and at first came slightly to his right and stopped behind a clump about ten yards from me and immediately in front. I felt distinctly unhappy while he stood for a few seconds looking straight down the hill under my dangling feet, which I kept remarkably still, for if he had chosen to come down on that line he would have been within five yards before I could have fired, at which distance he would have been on the same level as myself and the merest hop would have brought him into the machan. If he had come on only a brain shot could have kept him out and even at that range the brain of a moving tiger may well be missed. However, to my relief, he thought that wasn't quite the best line and turning to his left went about thirty-five or forty yards along the hill and then turned and went at a swinging trot down the slope. As he turned I slued round to the right and was able to get a very quick shot as he crossed the cleared passage I had made. He collapsed to the shot and slithered down the hill out of sight gradually, getting about thirty yards, during which time he uttered three of the loudest roars I have ever heard a tiger emit. The air fairly quivered and I thought I felt the machan vibrate under me, though it may have been my own tremors and not only those of the air. The beat, of course, stopped and I heard the beaters scrambling for safety. A. K. told me afterwards with gurgles of laughter that some of the bamboos were so loaded with men

that they almost touched the ground. I sat tight and heard the groans of the tiger evidently dying. In a few minutes I heard A. K.'s voice far to my right asking what was up and should he come. I shouted in reply to him to stop there and that I thought the tiger was dead. I then dropped out of my seat and went along the hillside towards him. I saw the tiger lying on its side apparently dead, about forty yards below me, but determined to have some company with me before investigating more closely. So I got to A. K. and explained the situation to him. Taking a few men with us we returned, and by pitching a few stones, found that the tiger was dead.

I found I had hit him rather far back and high up, cutting up his liver, so causing much pain, and a fairly speedy death. Evidently too, some splinters had injured the spine which had paralysed his hind quarters and prevented him travelling any distance. Probably if it had been level ground he would not have moved five yards with his hind quarters so disabled..

On skinning him we found a bullet, or rather a cylindrical chunk of lead, evidently fired by a local shikari, encysted in the shoulder muscles close under the skin. The villagers told us he had been known for a long time about those parts. He had once killed the village headman, a Raj Gond, whose ghost subsequently rode on his back. This ghost was apparently rather a nuisance to the people for he was supposed to suggest to his steed that his clothes were dirty or that his hair was getting long, etc., etc., whereupon the tiger would slay a dhobi or a barber, as the case might be, for his satisfaction.

After this beat, I explained to A. K. that if ever we got another tiger in this hill, I should prefer to sit in another place, as the tiger was apt to come uncomfortably close to one, while the shooting conditions were fluky in the most favourable event. I could by no means guarantee that I should be able to repeat my good luck in putting in what was practically a snapshot with fatal results. The opportunity came, as far as I remember, in the next camping season, when I was repeating the same tour and A. K. had again preceded me to tie out. This time he met me with the

information that, though there were tigers about, the kills had not been taken, so in the afternoon I took him with me for a walk round to look up the possibilities. On reaching the end of the hill which I have already described, we became aware of a most unpleasant smell at which we stopped simultaneously and pointed. There was evidently something dead close at hand on the hill, so, as two faint footpaths crossed where we were standing, I told A. K. to tie up there and we went quietly back. During the night the kill was taken and while the beaters were collecting I went with A. K. and we selected a suitable tree, this time at the foot of the hill on the line by which the former tiger was heading down when I shot him.

After the usual preliminaries and delay the beat started and again, when it was about half way through, the tiger appeared coming down the hill at a fast trot. I first saw him about 40 yards off and to my dismay heading straight at my tree. We had chosen a tree too exactly on his line and not, as I prefer it, some yards on one side. There wasn't much time to consider, and I fired at the point of his shoulder. Owing partly to the tiger's position and pace, and partly to flurry, I missed the point, and, as I subsequently found, hit him in the heavy muscles outside the shoulder blade. He broke into a gallop and passed growling under my tree. I swung round on my seat and as he disappeared into the jungle, broke his hindleg, which I just saw give way and swing. I waited in disgust and some dismay for A. K. to arrive. It was my first tiger not killed clean, I had no elephant, and there were no buffaloes handy to call in and I didn't feel happy. However, on A. K. turning up and hearing what had happened, he said, "Right oh! Sahib, we will take a few men and go and look for him." I consented, and having collected some half dozen men with spears and axes, we started on the line of blood, A. K. on my left hand and the others following. I kept my eyes skinned in front while A. K. followed the blood trail. For a short distance he stuck close to me, but gradually, as usual, in spite of being spoken to, he worked a few yards ahead. We had not gone more than 150 yards or

so when there was a coughing roar some thirty yards ahead, a simultaneous cry from the men of "There he is!" and the tiger charged. We were still in an open bamboo jungle with no undergrowth so that visibility was good. The tiger had been lying in a slight nala depression behind a scraggy clump of thin bamboos and he burst through this straight on us. I remember distinctly my first thought was "Somebody's in for a mauling now." My second thought was rather curious. Most of my readers will remember in the days of their childhood a certain toy, I believe of Chinese manufacture, consisting of a snake made of a thin spiral shaving of horn to one end of which was attached a gargoyle-like head. My second thought was "The tiger's head now is just like my snake's head." My third thought was more practical, for I saw that the tiger's eyes were fixed solely on A. K., the leader, and on no one else, and that this gave me my chance to confute thought number one. As the tiger started A. K. turned to bolt; I, seeing the tiger was after A. K. alone, stood fast, and as I had a bamboo clump behind me was practically invisible to the tiger as long as I remained still. A. K. passed me at about four yards distance with the tiger gaining rapidly on him in spite of the broken leg, in fact as the tiger came broadside to me, A. K. was not more than five yards in front of him. At this point I fired behind the shoulder on which the tiger collapsed. I fired the left into his chest somewhere, and then legged it behind a bush about twenty yards off. Reloading hastily, as he was still groaning and kicking, I put two more barrels into the beast's ribs which reduced him to stillness.

A. K. then turned up rather breathless, but jubilant and thankful for a narrow squeak, and we sat down to discuss things. From my side I expatiated on the advisability of placing the machan to one side of the tiger's line so as to afford a broadside shot, and thus minimise the chances of awkward shots such as I had just had to take with the subsequent unpleasant consequences of walking up.

It now transpired that the unpleasant smell, which had attracted our attention the evening before, came from a bear

which the tiger had evidently killed and eaten, for the beaters brought down the remains, consisting of a strip of skin down the back to which were attached the four paws and head, the entire body and limbs having been eaten.

I may add that our cogitations over these beats resulted in our taking the hill the reverse way on future occasions with good results. One Christmas, after vainly trying to get some one to come out for a Christmas shoot, I got three tigers on Boxing Day all dead within twenty yards of my tree. Later, again, we got a fine tiger for the Conservator, sitting in the same tree. In this latter beat I was sitting in another machan with a raging toothache and didn't care much if the forest was packed with tigers, or whether my boss got one or not.

I should like to record one or two anecdotes about Akbar Khan as he was a well-known character, and I was indebted to him for most of my good fortune in getting tigers. He was a big, rather loosely built, heavy man, quite independent and free spoken and no respecter of persons who couldn't shoot straight. He was a native of Allahabad district and had resigned to become the shikari of a Police Officer who shortly afterwards left the service and so he came to me and remained with me till his death some eight years later. He was one of the few shikaris I have known who had an instinctive knowledge of a tiger's ways and was able to arrange a beat in a jungle which he had never seen before. Most of these men are very good in their own neighbourhood where they know the country and have been accustomed to work, but are of little use in strange jungles. A. K. would go to a new place, and after picking up some fairly intelligent villager, would walk round and select his places to tie up. Further talk over the fire at night, generally with the help of a little liquor to loosen the villagers' tongues, would give him all the information he needed and he would have a very clear idea the next morning of how to take the beat from any individual kill and it only remained to select the exact tree for the machan. I always took a hand in this, for until I had drummed into his head what I required, he was apt

to put me too directly on the tiger's line. I also always put up the nearest stops on either hand and told them exactly what to do under different contingencies, as I found A. K. was apt to be too general in his instructions to these important men. The further stops and the running of the beat I always left confidently to him.

In our early days he generally roped in all the neighbourhood to beat, and I remember frequently having about 250 beaters, which was expensive even in those days, but I gradually persuaded him to be content with fewer men, and in favourable places we have killed our tiger with twenty or twenty-five beaters and stops.

He was absolutely devoid of fear of a tiger either fresh, or wounded, or a man-eater. As I have mentioned elsewhere, he placed a reliance on my shooting which was fortunately well founded on the few occasions when we had to approach a wounded tiger. He would frequently go poking round when he came up with the beat, before I could get down and join him. On one occasion I had a pal H. out for a trip in the hot weather. The country was very dry with very few pools or even shady places in the nalas. We had been hunting a tigress all day in a large area of very undefined jungle and had had two rather extensive beats in which nothing turned up. It was in the afternoon and we were all pretty fagged when we decided to have a final try over a third piece of ground. As it was late and there was not much time to tie up machans we were not very hopeful, so we determined to stand on the ground. The beat was to bring in a section of the jungle at right angles to the nala which was here about fifty yards wide with a dry sandy bed. H. took his stand on the bank towards the beat where it was ten or twelve feet above the bed, while I went to the other bank about one hundred yards lower down where the banks on the both sides sloped gently into the river. I could see H. from my position, and when the beat was fairly close, I saw the tigress trotting across an open bit about forty yards from him. The tigress stumbled and spoke to his shot then

galloped on and I lost sight of her almost immediately in some small bushes. I asked the man with me if he could see where she had gone and I understood him to point to a tree on my side of the nala. It turned out subsequently he meant a tree on H.'s side. I then went to H. who was very disgusted and said he had only broken a hind leg and then lost sight of her. I told him what I understood, and we went up to the point. I had in mind to look for the blood trail. We had hardly got there when we heard the roar of a charging tiger and some confused shouting. Doubling towards the scene of action we met A. K. and a Forest Guard, Nanki by name, also a very useful shikari, both in fits of laughter. They explained that they came up and took up the blood trail from where the tigress was hit and followed it a few yards only, when the tigress came at them out of a bush. She got so close that A. K. rammed the butt end of the hog spear which he generally carried in the beat, into her mouth, and then both men chucked themselves over the bank into the bed of the nala. She chewed about eighteen inches of the bamboo into splinters and returned to the bush where she had been lying. There we found her sitting up looking very cross and finished her after several shots into her chest.

On another occasion I was out with G. of the Police. A tigress came out to G. who fired. The tigress went on and there was no growl or blood to show that she had been touched. We went round to beat the patch into which she had gone and she came out to me, when I shot her. We found that G.'s shot had just touched her taking out a piece of skin and flesh on the back behind the withers. A. K. on coming out said he had found blood just after starting the beat and knew the beast was wounded, yet he had never thought of stopping the beat to let us know, and had followed the blood through the beat. If we had known she was wounded we should have made all sorts of elaborate arrangements to get at her and in this case, as she was in no way crippled or apparently inconvenienced, we should probably have lost her.

Shooting etiquette was quite beyond A. K.'s comprehension and he was very disgusted on being told that this was G.'s

tigress. The drawing of lots for positions in a beat was also a sealed mystery to him. He often said to me, "You do something with bits of grass and I never know when I come through with the beat where I shall find you sitting." It was just as well for he was quite capable of making alterations in the interior of the beat to try and bring the animal to me, which would probably have upset the tiger's equanimity in his progress.

(To be continued.)

GENERAL NOTES ON NURSERIES AND PLANTING FOREST TREES IN THE CINCHONA PLANTATIONS, MUNGPOO, DARJEELING DISTRICT.

1907-08—1917-18.

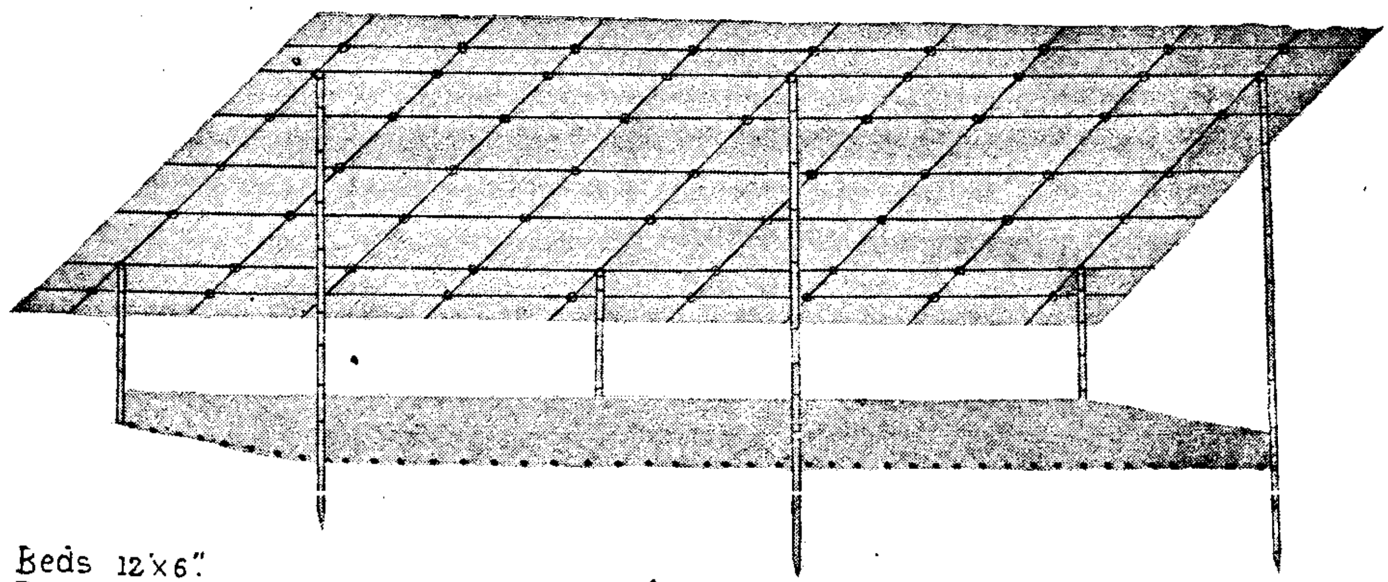
Good nurseries are just as essential for raising forest trees as for any other class of plants. Many Forest Officers who have visited Mungpoo during the last few years I am sure are quite convinced that good nursery work has made Mungpoo planting the success it is.

Seeds best sown in covered nurseries.—*Bucklandia populnea, Schima Wallichii, Alnus nepalensis, Betula cylindrostachys, Engelhardtia spicata, Hovenia dulcis, Cordia Myxa, Ehretia cordifolia, Cryptomeria japonica, Cedrela Toona, Bischofia javanica, Terminalia myriocarpa, Duabanga sonneratioides, Morus lævigata, Ailanthus grandis, Anthocephalus Cadamba, Nyssa sessiliflora.*

All these species bear fine seeds—very fine in the case of *Betula* and *Duabanga*. Covering is most essential to be successful in raising these seeds—to protect from the very drying sun in March and April and from heavy rain from May till the middle of July.

Seed of nearly all species given above is ready for sowing at the end of March, *Cedrela* in April, *Morus* in May. Nurseries should be prepared in the hills on the easiest slope it is possible to find so as to avoid heavy expenditure in cutting terraces. A northerly aspect is desirable. The nurseries should be as close as possible to the area to be planted, that is provided perennial water is available. These essentials being fixed on proceed to

Fig 1
Rough Drawing of Nursery.



Beds 12'x6'.
Front Posts 5'. Back Posts 2' 6".
Dotted line ground level. Raised Bed 6".

cut terraces 10 feet wide. The 10 foot width is divided into 6 feet for actual seed beds, and 2 feet on either side for pathways to facilitate watering and cleaning space. I do not advise that any series of beds should be more than 120 feet long, that length to right and left of a central gangway down which the water-supply can be taken in bamboo drains, is most convenient. The actual 6 foot bed is dug over to a depth of 1 foot, and is raised 6 inches or more by the addition of soil from the pathways, and with leaf soil collected from any near by jungle. The addition of leaf soil is most essential to grow the seedlings as rapidly as possible and to induce fibrous root growth. The actual beds being prepared, the framework to support covering for the beds is now erected of posts of bamboo, or any other material at hand, 6 feet 6 inches for front, and 4 feet for back posts. The posts are sunk into the ground 18 inches, thus reducing the height above ground to 5 feet, and 2 feet 6 inches respectively. The posts from back to front will be 6 feet apart, and 12 feet from post to post, running with the beds. Light framework for supporting the covering is built on to the posts. Bamboo mats or any thatching material is laid on and secured. The covering need not be so thick as to be absolutely waterproof. Two thicknesses of bamboo mats is sufficient covering for most seed beds. Fig. I is a rough drawing of a nursery.

The original soil in the beds and added leaf-soil is mixed and well watered if dry. The surface soil is freed of lumps, roots, and stones, so that the seeds may be on an even surface.

Seeds should not be sown too thickly (except in the case of *Terminalia myriocarpa*, which is a bad germinator). Seeds are covered with a thin layer of sifted soil. A light watering with a fine rose-can (Haws' patent) is immediately given, this settles both soil and seed and produces a state most favourable to germination.

We are now at the stage when seed of all species has been sown; careful watering by a mali doing *whole-time work* at the nurseries is all that is necessary till the seed has germinated, then the beds must be weeded. This is best done by women, they

carefully pull out all weeds at the same time, with pointed sticks loosen the earth round the seedlings, and remove moss and fungus growth. This loosening of the earth is most beneficial to the seedlings and they at once make a decided spurt.

After the seed sowing more covered nurseries should be prepared, and leaf-soil added as before. These nurseries are for pricking out the seedlings into. My diary gives the bulk of my seeds being sown about the middle of February. Seedlings were all ready for pricking out by middle of May. The seedlings then averaged ½ inch to 1 inch and more in height. Pricking out is systematically carried out distance apart 2″ × 2″ or 3″ × 3″ according to the habit of the seedlings. Measuring boards 6 feet long by 2 to 3 inches wide with 2 to 3 inch notches cut on them are used to ensure equal spacing.

Women working under an experienced mali do the pricking out, and the important point to watch is that the women make holes deep enough with their fingers to ensure the roots of the seedlings not being curled up. As the seedlings are pricked out sprinkle with a fine rose-can, as before, in the seed sowing. The amount of seedlings required with a fairly wide margin for failures is pricked out. Perhaps a fortnight after pricking out weeding and loosening of the soil becomes necessary. More weedings and loosening of the soil are advisable, at intervals, as required. From 15th June to 15th July, the seedlings of all species should be from 4 to 6 inches high, some larger, it is at this stage that they are planted out. The seedlings having been grown under cover they are naturally very tender and must be hardened *gradually* before being exposed to all weather. To illustrate this point it may be taken that two bamboo mats have been the covering. In hardening the seedlings remove one mat only, then after a week or so remove the second mat, after that, in a week or ten days the plants will be hard enough to stand heavy rain and strong sun.

It may be thought that such small seedlings would not stand planting in the open, but as a matter of fact my experience in afforestation work, now extending over ten years, has taught me

that the only safe and successful way of planting is to put out small seedlings. This class of seedling is much more easily handled and has not had time to develop an enormous root system, which is sure to be damaged, when uprooted; moreover the smaller seedling is better able to withstand the effect of wind and rain than the large plant kept in nurseries for a year or more. There are a few species that may safely be kept in nurseries for a year or more, they are—*Bucklandia*, *Cryptomeria*, *Juglans*, and possibly *Michelia*. I haven't much experience of the latter. I do not mean to imply that these species are to be kept in covered nurseries for a year or more, they will be brought under cover to the stage when heavy rain, etc., will not damage or wash them away and then be exposed to the full light till next planting season.

Planting.—From 15th June to 15th July is the best season for this at elevations between 1,000 and 5,000 feet. The seedlings having been uncovered to harden, planting may be carried on with all possible speed, of course selecting dull weather which is most likely to prevail from 15th June. The area for planting will have been lined out and thalied in the dry season, so that nothing should check planting once started on.

Boxes made of ½ inch lightwood 2′ × 18″ × 4″ are used for carrying. These are carried on light wooden carriers, two boxes on each carrier.

Uprooting of the seedlings at the nurseries requires to be carefully done by men using hand forks, so that every seedling is lifted with a ball of soil adhering to the roots. The boxes are loaded fairly lightly to minimise shifting and shaking of seedlings in course of transit. As the boxes of seedlings arrive at the planting area picked men are waiting to plant them.

With each pair of planters is a woman or boy, whose work it is to take the seedlings carefully from the boxes with the ball of soil as it came from the nursery beds, lifting by the collar is to be avoided at all cost. The planter makes a hole of the required depth and his helper holds the seedling in the hole till the soil is pressed firmly enough to prevent the seedling sinking. The

thalie is smoothed off and left slightly higher than the surrounding ground, so that no water may collect in or around it.

Cleaning.—It may be thought by those interested in forest work generally that the planting of such small trees demands a great deal of attention by way of cleaning and weeding for the first year or so after planting. It does demand a great deal of attention, but it is well paid for, because invariably 95 per cent. of small trees go away with a straight leader and form a perfect symmetrical tree, such as is not always to be seen in a plantation put out with one to two year old seedlings. The large seedling has to battle with sun and wind to a far greater extent than the small seedling which is firm in the thalie and surrounded by short jungle acting as a protection.

Planting will be finished by the end of July, the thalies being left quite clean. About the end of August it will be necessary to go through and weed the thalies, and if time and money permits a light hand forking will be most beneficial to the young trees. The trees will now stand until October, when a final cleaning to stand all through the dry season should be given.

For trees planted on dry stony ridges the danger comes in the dry season. Their roots have not got down to any great depth and in excessive drought the trees are likely to die off through lack of moisture. This danger can be eliminated to some extent by mulching the thalies at the final clean-up at the end of the rains. Surrounding the thalies will be jungle growth of all kinds, select from this the kind known to decay quickly (Ageratum makes a splendid mulch) and put three or four inches on the cleaned thalie, covering with soil to prevent the mulch being dried up or blown away. Mulch should not come into actual contact with the collar of the tree.

The expenses of mulching is not great, and it need only be done on the driest ridges.

Distance apart for planting forest trees.—I have tried various distances 12′ × 12′, 8′ × 8′, 6′ × 6′ and the closer planting seems to be the best.

Trees planted closely, slow growers with fast growers, help each other, and in three to four years close up and seclude all light necessary to the growth of useless undergrowth.

Fuel trees, such as *Betula*, *Alnus*, *Schima*, and *Hovenia* can be mixed with good timber species. At the tenth year or so the fuel trees may be cut out giving very serviceable fuel while the good timber species will be left to develop. By such judicious mixing several purposes are served—a quick return of fuel wood is obtained, damage from insect pests is to some extent kept in check, and if required a block of pure species is left to develop for timber.

A statement showing the height and girth of several species of trees planted on Mangpoo 1906-07 to 1916-17 is herewith given.

The number of trees of all sorts planted on Mungpoo from 1906-07 to 1916-17 is roughly 25,69,200, and the area covered is 2,838 acres.

P. T. RUSSELL,

Superintendent,

Cinchona Cultivation, Burma.

Measurements of Fuel and Timber Trees of different species planted

Serial No.	Species.	Nepali name.	10 Years.		9 Years.		8 Years.	
			Hgt.	Gth.	Hgt.	Gth.	Hgt.	Gth.
1	Quercus semiserrata	Budgrat	38·9′	18·3″	28·9′	12·2″	...	11·8″
2	,, spicata	Arkowlo	...	...	...	...	...	6·3″
3	,, lineata	Chalat	...	...	27·1′	15·4″	...	2·8″
4	Castanopsis indica	Dalne katus	..	...	...	..	...	...
5	Bucklandia populnea	Pipli	...	...	27·9′	18·7″	...	...
6	Schima Wallichii	Chilauni	...	...	48·8′	25·8″	...	14·6″
7	Alnus nepalensis	Utis	...	...	67·7′	24·5	...	23·9″
8	Betula cylindrostachys.	Saur	...	...	66·8′	24·5″	..	21·5″
9	Engelhardtia spicata	Mowa	..	...	...	..	...	5·2″
10	Hovenia dulcis	Bange-kat	...	...	...	..	...	...
11	Cordia Myxa	Boeri	...	...	...	.	...	...
12	Fraxinus floribunda	Lakoori	...	...	...	..	...	...
13	Shorea robusta	Sakwa	...	...	...	..	14·5′	7·0″
14	Bischofia javanica	Kainjal	...	...	...	..	...	...
15	Terminalia myriocarpa.	Panisaj	...	...	...	..	...	...
16	,, tomentosa	Pakarsaj	...	...	...	..	...	...
17	Duabanga sonneratioides.	Lampati	...	...	...	..	...	...
18	Cedrela sp.	Tooni	...	...	...	..	19·6′	8·2″
19	Morus lævigata	Kimbu	...	...	...	...	..	...
20	Ailanthus grandis	Gokul	...	...	...	..	...	...
21	Anthoceplalus Cadamba.	Kadam	...	...	...	..	...	...
22	Acrocarpus fraxinifolius.	Mandanay	...	...	...	...	...	...
23	Albizzia procera	Setoo-siris	...	...	...	...	...	...
24	Nyssa sessiliflora	Lak-chilauni	....	...	...	...	...	...
25	Machilus sp.	Kowla	...	...	...	...	...	...
26	Acer sp.	Kabashi	...	...	...	...	...	...
27	Prunus acuminata	Lale	...	..	...	...	...	...

Average measurements of

in the Cinchona Plantation, Mungpoo, 1906-07—1916-17.

7 Years.		6 Years.		5 Years.		4 Years.		3 Years.		2 Years.	
Hgt.	Gth.	Hgt.	Gth.	Hgt.	Gth.	Hgt.	Gth.	Hgt.	Gth.	Hgt.	Gth.
17·2′	12·2″	16·6′	8″	..	...	8·2′	3″	...	6·5″	4·1′	...
...	...	10·5′	4·8″	...	...	4·0′	1″	...	...	3·0′	...
...	...	...	...	...	...	9·5′	3·1″	...	...	3·0′	...
...	...	19·0′	10·0″	...	...	...	...	...	...	3·5′	1·6″
...	...	...	...	15·0′	7·9″	11·8′	4·7″	7·4′	3·0″	5·2′	3·1″
32·6′	12·3″	18·7′	10·6″	21·7′	10·6″	14·2′	7·1″	7·0′	2·9″	6·5′	3·9″
27·3′	11·5″	28·0′	13·5″	35·4′	18·7″	31·8′	16·1″	21·3′	9·1″	12·[illegible]′	5·9″
46·9	19·1″	28·9′	12·7″	35·5′	13·8″	23·2′	9·6″	13·2′	5·4″	12·0′	6·1″
...	...	11·8′	6·6″	9·9′	6·7″	9·7′	4·9″	5·1′	2·4″	4·1′	3·1″
...	...	...	...	...	...	...	...	...	...	8·7′	...
...	...	10·6′	4·3″	...	...	...	...	...	..	...	...
...	..	9·0′	4·0″	...	...	--	...	3·4′	1·0″	2·9′	...
...	...	10·9′	3·9″	...	...	5·8′	2·0″	2·5′	1·0″	3·3′	1·2″
...	...	...	...	19·7′	9·0″	15·0′	9·7″	12·5′	7·2″	7·3′	4·0″
...	...	28·1′	15·2″	31·5′	12·3″	18·9′	8·3″	8·9′	4·6″	8·6′	5·0″
...	...	19·4′	11·3″	...	...	11·2′	4·9″	11·2′	5·8″	11·4′	5·0
...	...	26·8′	17·1″	25·3′	13·8″	24·7′	16·3″	14·2′	10·2″	9·4′	7·6″
14·9′	6·7″	15·4′	8·9″	14·7′	7·4″	10·0′	4·5″	12·3′	6·5″	5·9′	3·5″
...	...	13·4′	5·0″	14·0′	5·0″	20·1′	6·6″	14·4′	5·1″	7·1′	3·4″
...	...	12·6′	8·2″	...	...	20·2′	9·5″	4·5′	1·0″	..	...
...	...	14·6′	7·5″	23·4′	11·6″	21·5′	10·8″	...	..	8·2′	4·9″
...	...	10·5′	1·1″	17·0′	5·0″	...	...	...	...	12·1′	5·0″
...	...	19·6′	9·5″	...	...	...	...	...	...	6·2′	3·2″
...	...	...	...	...	...	8·7	3·7″	...	...	3·4′	...
...	...	...	...	...	...	11·1′	5·0″	...	...	3·4′	...
...	...	...	...	...	...	9·0′	2·1″	3·8′	...	3·9′	...
...	...	...	...	...	...	...	...	...	...	3·3′	...

50 trees of each species.

P. T. Russell,
Superintendent,
Cinchona Plantation.

NOTE ON THE DEATH OF CHIR *(PINUS LONGIFOLIA)* POLES IN THE ALMORA PLANTATIONS OF KUMAON.

BY H. G. CHAMPIONS, I. F. S.

(Continued.)

III. Insects.—The general account of the chief insect pests of *Chir* by Mr. Beeson, given on pages 63—65 of Troup's "*Pinus longifolia,*" describes the insects which may be expected in moribund trees. Careful observations of the first insects to appear in sickly trees have been made in all cases for the 100 numbered trees of Sitoli as well as of scattered trees elsewhere and only the following can be thought of as even possibly primary :—

(i) *Ripersia* sp. (C. F. Troup, loc. cit., p. 65) is often common on natural regeneration and young plantation trees especially under shade: it is not impossible that attacks of this Coccid may facilitate an infestation by *Peridermium* or by other insects but the fact that it is rare in the Almora Plantations (except Bandanidevi and to a less extent Manila) shows that it cannot be the chief cause of the trouble.

(ii) *Retina* sp. (Lepidoptera, Tortricidæ).—The larva of a moth with habits similar to those of the well-known species of this genus common in Europe, is very frequently met with in trees attacked by *Peridermium* under conditions which suggest that the fungus was the first arrival. The "pitch tubes" extruded through the bark mixed with characteristic excrement and silken thread make it easy to recognise the attacks of this insect though the writer has not been able to breed it out, nor to find he adult. Full grown larvæ and pupæ may be found in July-August. The attacks usually continue several years and cause a good deal of resin bleeding: the larva feeds on the inner cortical tissues and ultimately causes girdling and when quite small plants are attacked as sometimes occurs, this may soon kill the tree. This mav be

the same insect as attacks the leading buds or shoots mining in the pith.* The insect is recorded as infesting at least 20 of the 100 Sitoli trees and actually appears in practically every tree which has definitely become sickly so that whatever its status as a primary, it is certainly an important contributory cause of death.

Cryptorrynchus brandisi, Stebbing.—This insect and its work is described and illustrated in detail in Stebbing's "Forest Insects" on pages 428—436 and there is a special reference to the Almora plantations on p. 431. The observations now made agree in a general way with the account given of the life history of the insect and its relations to the forest. Stebbing makes however, the tacit assumption that the insect attack is the primary cause of death, which requires proof. Data collected bearing on this point are as follows:—

(1) As result of general observations in 1918 in Kalimath it was noted:—

"As numerous dying trees are found in which the insect does not occur, the latter is clearly in this place secondary."

(2) General observations in 1919 in Sitoli were summarised "*Cryptorrynchus* very common: maximum infestation beneath maximum external bleeding and near maximum *Peridermium*." Dying trees without this insect were also noted.

(3) Notes on a dozen trees selected in 1918 from Sitoli for periodic examination lead to the conclusion in 1919 "*Cryptorrynchus* comes early into cankered spots and the bases of dead branches and is secondary to the causes of such canker, etc."

(4) After the 1922 inspections it was considered that the data recorded so far indicated that "the *Peridermium* probably first attacks the trees finding entry through

* I noted in July this year abundant work of this or an allied species in the carroty base of the stems of small *Chir* regeneration seriously damaged by fire in Maharpali reserve.

wounds caused by lopping of the lower branches or casual injuries and the first resin flow may be ascribed to this fungus. Cankerous spots are thus started and into them the first insect arrival for the larger trees is usually a Lepidopterous larva (? *Retinia*) whose feeding activities give rise to "pitch tubes" and more bleeding, and then later, *Cryptorrynchus* follows. In small plants there is no canker and the weevil is the first insect usually found."

(5) in June-July 1921, a good many trees were examined and only 2 or 3 larva of *Cryptorrynchus* could be found at all even in the almost dead trees: no fresh emergence holes were recorded on the numbered trees and it is evident that *Cryptorrynchus* is not causing the death of trees this year.

(6) Up to the last inspection on 19th July 1921, of the 100 numbered trees, No. 35 showed a trifle of resin bleeding in 1919, *Cryptorrynchus*, *Retinia* and *Peridermium* in 1920; Nos. 11, 24, 25, 52, 56, 57, 76, 90 and 94 developed the fungus first, insect attack becoming apparent at a subsequent date, Nos. 24, 56, 76, 90 and 94 finally succumbing; Nos 5, 20, 85, 88, 89, 97 have died without *Peridermium* being recorded, but it must be borne in mind that the fungus is rarely to be recorded except when fructifying, whereas inspection in none of these cases properly coincided with this event in May, and in 2 of them, only a single inspection was made in September. On the other hand the conditions of the experiment preclude to a less degree proper search for insects.

The writer, basing his opinion on the observations given, considers that in these plantations, *Cryptorrynchus* infestation follows infestation by *Peridermium*, that if the fungus were eliminated, the mortality would fall to normal, and that if the weevil were exterminated, other insects would finish off fungus infested trees almost or quite as efficiently.

Polygraphus longifolia, Stebbing.—This abundant insect is described in detail with an illustrative plate on pages 524—527 of Stebbing's work already quoted, much of the information given having been collected in these plantations. Most of the records given here have been confirmed. Several cases have been noted where trees have died with no injury visible except that due to this insect,* though *Peridermium* may have proceeded it. In such cases, and in fact almost as a rule, *Polygraphus* attacks the soft cortex of the branch wood and crown in vast numbers,† the main trunk being untouched. In August 1918 and September 1919, it was particularly abundant, predacious insects such as *Hypophlœus, Niponius,* etc., being frequent on the latter occasion. In 1920 it was less common and on inspections in June and July 1921, it could hardly be found despite the unusually large number of sickly trees. The available information may thus be summarised to the effect that *Polygraphus longifolia* varies greatly in its abundance, sometimes associated with *Cryptorrynchus,* etc., and sometimes alone ; in the latter case it may be the only insect to be found in a dead or dying tree ; most usually it attacks the crown and branches of already sickly trees and is very probably secondary in all cases though undoubtedly hastening death.

Notorrhina muricata Dalm., a small brown longicorn, extremely active and extraordinarily fragile, appears to vary greatly in frequency, in some years being difficult to find and in others, quite abundant. Details are given by Stebbing on pages 281—283 of his book already quoted, in modification of which it may be noted that the dates of emergence range from the end of April (29-4-19, to late in July (20-7-21 when full grown larva, pupa and immature adults were found, showing that emergence probably continues well into August) and that it

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* It is possible that more than one species is included in the notes of this paragraph.

† I have twice recorded on the spot that appearances were suggestive of these swarms having attacked the trees as adults for feeding purposes as is known to occur with other *Scolytidæ*.

appears quite possible there may be two broods, since full grown larvæ were found freely in the latter part of September. Tree No. 94 *which died this year was found full of larvæ and pupæ* of this insect unaccompanied by any others (or visible work of others) except 2 or 3 small *Cryptorrynchus* larvæ; No. 87 was similar except that there were also a few *Retinia* larvæ; No. 67 was found full of larvæ and pupæ where the cambium was dead and feeding larvæ above and below the girdling—no other insects. Small trees to 10" girth are liable to be attacked but trees of 1½ girth or more are preferred.

This insect thus appears to take a similar part in the death of the trees as does *Cryptorrynchus*, but is generally less common and multiplies less rapidly and is accordingly of less importance. To all appearances, however, on occasion it can finish off a tree without help from other species.

Ips longifolia, Stebbing, figured and described by Stebbing on pages 557—561 of his book, is so rare in the plantation as to be altogether precluded from consideration in the present connection. Occasionally it is found with the species already described, in small numbers, and usually after the death of the tree is already sealed from other causes.

Melanophila ignicola, Champ., bears a somewhat similar relation to the death of the trees as the last described insect.

Platypus biformis, Chapuis.—The common shot-hole borer of *Chir* stands in an even less direct relation with the mortality in these plantations.

Summary.—For the last 15 or 20 years at least there has been a considerable mortality among the *Chir* resulting from sowings made since 1875 in the vicinity of Almora, this mortality particularly affecting the young plants 3—12 years old on poor dry soils, but sometimes extending to well established growth on good soils. This mortality is sufficient to nullify attemps to complete the stocking on the poorer areas, and in the course of 3 years a sample plot of trees of 1½'—2' girth in a good locality has lost 25 per cent. of its dominant trees; it has not extended to the poor quality growth of the oldest plantations now up to 46 years old.

The general indications are that the internal parasite described as *Peridermium complanatum var. corticola* by Barclay is in all cases primary; that its presence is very easily overlooked at first, but reduced resistance and the flow of resin ultimately caused, attract various destructive insects, of which the chief are *Cryptorrynchus* and a Tortricid moth, and of less importance but still by no means negligible, *Notorrhina* and *Polygraphus*. *Ips* and *Platypus* do not have to be taken into account.

Control.—The figures given in the tabular statement below give some idea of the number of plants which have been grubbed up and disposed of during recent years. Much of this work has been done under the instructions of the writer, the orders being *to remove trees immediately they show signs of going off colour*, cutting a few inches below ground level, to remove promptly from the plantation and burn, the work to be continuously carried on by the local Forest Guard. In practice it has so far proved impossible to get this done promptly and it appears as though nothing short of very summary punishment for failure to comply with orders will ensure the work being properly done. Hitherto orders have not been given for the removal of every stem showing the fungus on the bark, or copious resin bleeding indicating its presence and that of the insects enumerated; the reason for this has been the very large number of such plants and the uncertainty as to whether such drastic measures are necessary. In consideration of the facts detailed here, the writer is prepared to urge that:—

(i) Every tree in Sitoli showing heavy bleeding be removed and burnt at an early date.

(ii) In Kalimath, Deolidanda and Ghurari *every plant* showing fungus fructifications be removed and burnt, this to be repeated during 2 or 3 years, as long as necessary, all sowings being held up meanwhile in Kalimath but continued over the other 2 small areas.

(iii) In Baldhoti a sample plot of at least 200 plants be laid out and mapped and a careful record kept of the condition of the plants on the same lines as has been done in Sitoli, with the special object of seeing

whether infestation by fungus necessarily involves death. Further sowings to be held up till a result has been obtained from (ii).

(iv) Any extensive sowing made in the next few years be made in a new uninfested area, the prescriptions of (ii) being carried out.

(v) The observation plot in Sitoli be maintained carefully with more frequent inspections especially in the hot weather.

(vi) In all the other plantations of Central Almora and Ranikhet Divisions where bark *Peridermium* is beginning to make an appearance, careful inspections be made at the end of April and early in May and all infested plants rooted up and burnt *before the spores are shed.*

It is necessary to mention that the plantations close to Almora are isolated from other pine forests and that the danger of infestation from outside is on the whole small: the areas of high mortality are similarly at least a mile apart.

The control work for the present should be continuous throughout the growing season of March to October and all series of observations must include an inspection at the end of April or early in May, when only can one be sure of seeing the fungus. The particular practical difficulty that the proposed fellings are liable to lead to illicit removal of healthy stems should not be unsurmountable with suitable arrangements for hammer marks and adequate inspection.

In conclusion, I have to acknowledge with thanks the help of Mr. W. J. Lambert in inspections in 1918 and on 1st August 1920, and of Forest Ranger Gopal Dass and Forester Bachi Ram of Central Almora Division on various occasions.

Girth on	21/9/19	11/7/20 R. O.	1/8/20	7/10/20 R. O.	16/2/21	28/4/21	20/6/21	19/7/21	REMARKS.
1	N ...	N ...	N ...	N ...	N ...	N ...	N ...	N ...	
2	RO ...	RO ...	RO ...	...	...	RO ...	R ...	R ...	
3	N ...	N ...	N ...	...	...	N L ...	N L ...	N ...	
4	P II RO ...	P II RO ...	P II_2c R_2 ...	D ...	D ...	D ...	D ...	D ...	
5	N ...	Ic ...	Ic ...	D ...	D ...	D ...	D ...	D ...	
6	N ...	N ...	N ...	N ...	N ...	N ...	N ...	N ...	
7	N ...	N ...	N ...	N ...	N ...	N ...	N ...	N ...	
8	RO ...	N ...	N ...	...	...	N ...	R ...	R ...	
9	N ...	N ...	N ...	...	...	N L ...	N ...	N ...	
10	RO ...	N ...	N ...	...	...	N ...	N ...	N ...	
11	P RO ...	P R I ...	P R I ...	...	...	P R_2 I ...	P R_2 I ...	P R I ...	
12	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
13	II ...	I P R ...	I P R ...	...	...	I P R ...	II_2 P_2 R_2...	I P_2 R ...	Since reported dead (17/9/21).
14	RO ...	N ...	N ...	...	...	N ...	N ...	N ...	
15	N ...	N ...	N ...	...	...	R ...	R_2 PO IIO	R_2 PO IIO	
16	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
17	N ...	N ...	N ...	...	...	N L ...	N ...	N ...	

on	21/9/19	11/7/20 RO	1/8/20	7/10/20 RO	16/2/21	28/4/21	20/6/21	19/7/21	REMARKS.
18	R ...	RO ..	R ...	...	...	R ..	R ...	R ...	
19	R ...	R Ic ...	R2 Ic2 ..	...	...	R2 Ic2 ...	R2 I2c ...	R2 I2c ...	Since reported dead (17/9/21).
20	RO ...	R Icl ..	R Ic2 1 ...	...	D ...	D ...	D ...	D ...	
21	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
22	D ...	D ..	D ...	D ...	D ...	D ...	D ...	D ...	Recently dead: Ic P2 including Platypus.
23	N ...	N ...	N ...	...	...	RO ...	RO ...	N	
24	P2 ...	P R I ...	P R I ...	...	D ...	D ...	D ...	D ...	No bleeding at 1st inspection.
25	PO ...	P I ...	P Il ...	...	...	P Il RO ...	P Il R ...	P Il R ...	
26	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
27	N ...	N ...	N ...	...	...	RO ...	N ...	N ...	
28	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
29	N ...	N ...	N ...	...	...	N ...	N ...	N ..	
30	N ...	N ..	N ...	...	...	N ...	N ...	N ...	
31	N ...	N ...	N ...	...	...	N ..	N ...	N ..	
32	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
33	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
34	N ...	N ...	N ...	...	..	N ...	N ...	N ...	

35	RO ...	R Icl ...	R Icla P ...	...	...	R Ic2 P ...	R2 Ic2 I P...	R2 I2 P ...	Initial bleeding very slight.
36	N ...	N ...	N ...	...	...	...	N ...	N ...	
37	N ...	N ...	N ...	...	...	N L ...	N ...	N ...	
38	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
39	R2 P ...	D ...	D ...	D ...	D ...	D ...	D ...	D ...	
40	R Il ...	R Il P2 ...	R2 P2 Ic.	...	...	R2 P2 ...	R2 I2 P2...	R2 I2 P2 ...	
41	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
42	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
43	N ...	N ...	N ...	...	...	N ...	N CO ...	N ...	
44	N ...	P ...	P ...	...	...	P2 ...	P2 IIR ...	P2 I2 R ...	No bleeding till 20-6-21.
45	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
46	N ...	N ...	RO ...	...	...	N L ...	N ...	N ...	
47	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
48	D ...	D ...	D ...	D ...	D ...	D ...	D ...	D ...	*c.f.* XXXII.
49	N ...	N ...	N ...	...	...	RO ...	R ...	R ...	*Peridermium* on adjoining tree of same patch.
50	RO ...	N ...	N ...	...	...	N ...	N ...	N ...	
51	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
52	PO ...	P I RO ..	P I RO ...	...	...	P I R ...	P2 I2l R2...	P I2 R2 ...	= XXXI.
53	Il ...	I P R ...	I P R ...	(I P R) ...	(I P R) ...	D ...	D ...	D ...	= XXII.

Girth on	21/9/19	11/7/20 RO	1/8/20	7/10/20 RO	16/2/21	28/4/21	20/6/21	19/7/21	REMARKS.
54	P2 I R	P I R	P I R	...	D	D	D	D	=XXIII.
55	N	N	N	...	...	N	N	N	
56	P RO	R R I2cl.	P R2 I2	...	...	D	D	D	
57	P RO	P R I1	PO RO I	...	...	P I	P R I1	P R Icl	Since reported dead (17-9-21).
58	N	N	N	...	...	N L	N	N	
59	...	N	N L	...	...	N	N	N	
60	...	N	N	...	...	N	N	N	
61	N	N	N	...	...	...	N	N	
62	N	N	N	...	...	N	N	...	
63	N	N	N	...	...	...	N	N	
64	N	N	N	...	...	N	N	N	
65	R2	I2l R2	I1 R2	D	D	D	D	D	
66	N	N	N	...	...	N	N	N	
	P2 I1	P2 I	P2 I2 R2	...	...	P Ic RO	P I2 R2	D	When felled full of *Notorrhina* adults, pupæ and larvæ: no *Cryptorrynchus* or *Scolytidæ*.
68	N	D	D	D	D	D	D	D	
69	N	N	N	...	...	RO	R	R	
70	N	N	N	...	...	N	N	N	

71	N	N	N	...	...	N	N	N	
72	N	N	N	...	...	N CO	N CO	N	
73	N	N	N	...	...	N L	N	N	
74	R	N	N	...	...	N	N	N	
75	N	N	N	...	...	N L	N	N	
76	PO RO		PO RO	D	D	D	D	D	
77	N	N	N	...	...	N	N CO	N	
78	N	N	N	...	...	N	N	N	
79	N	N	N	...	...	N	RO	RO	
80	N	N	N	...	...	N	N	N	
81	N	N	N	...	...	N L	N	N	
82	R2 I2 I P	R P	R II P	...	...	R P	RO I P	R I P	
83	D	D		D	D	D	D	D	Recently dead with P2 Ic.
84	N	N	N	...	...	N	N	N	
85	N	D	D	D	D	D	D	D	
86	N	N	N	...	...	N	N	N	
87	P II R	P I R		...	...	P2 I R2	P2 I R C2	D	*Retinia* and *Notorrhina* when felled : no insects in crown. No *Peridermium* could be found on 1/8/20.

	21/9/19	11/7/20 RO	1/8/20	7/10/20 RO	16/2/21	28/4/21	20/6/21	19/7/21	REMARKS.
88	N ...	I1 ...	I1 ...	D ...	D ...	D ...	D ...	D ...	
89	N ...	N CO –	N CO ...	D ...	D –	D ...	D ...	D ...	
90	RO PO ...	PO IO ...	PO IO ...	D ...	D ...	D ...	D ...	D ..	
91	PO I2 l R2	R I PO ...	R I PO ...	...	D ...	D ...	D ...	D ...	
92	I2 P ...	I CO ...	R2 I2 P ...	...	D ...	D ...	D ...	D ...	
93	N ...	N ...	N ...	...	...	RO ...	P ..	P RO ...	Resin out on branch only.
94	RO ...	P ...	R P ...	...	...	R2 P2 ...	R2 P2 I1 ...	D ...	Full of Notorrhina larvæ, pupæ and adults when felled: no insects in crown.
95	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
96	RO I1 ...	R I P ...	R I P ...	...	...	I1 P2 ...	I1 P2 CO...	I1 P CO ..	
97	N ...	N ...	N ...	D ...	D ...	D ...	D ...	D ...	
98	R I2c P CO	D ...	D ...	D ...	D ...	D ...	D ...	D ...	
99	N ...	N ...	N ...	...	...	N ...	N ...	N ...	
100	N ...	N ...	N ...	...	...	N ...	N ...	N ...	

N = Normally healthy.
R = Fresh resin bleeding.
P = *Peridermium* infected : shown present once it has been noted.
(Lost in no case in 29/4/21.)
I = Insects : c = Coleoptera : = Lepidoptera.

D = Dead.
L = Lopping injury (fresh) noted.
C = Crown unhealthy.
O = Defect present to slight extent only.
2 = Defect present to considerable exten .

XI	Girth...	1/8/18	11/10/18	19/5/19	21/9/19	1/8/20	29/4/21	20/6/21	19/7/21	REMARKS.
XII	1'·3	R Il ...	R Il CO	R I P2 ...	D ...	D ...	D ...	D ...	D ...	Healthy except for one diseased patch.
XIII	1'·2	P ...	P ...	P2 CO ...	P2 Il Rc	P I ...	P CO ...	P2 Il2 R	D ...	
XIV	1'·0	P R2 Ic2	P R2 Ic2	P2 R2 I2	P2 R2 Il2	P2 R2 I2	...	D ...	D ...	
XV	1'·6	N ...	N ...	N ...	R IlO P	R2 Il2 P2	R2 Il2 P	D ...	D ...	A thick bushy tree quite healthy except one dead bough.
XVI	1'·3	P Il ...	F Il ...	...	P R ...	P Ilc R...	...	D ...	D ...	
XVII	1'·1	P Ilc	P Ilc CO	D ...	D ...	D ...	D ...	D ...	D ...	
XVIII	2'·0	P Ilc ...	P Ilc ...	PO Ilc ...	PO Ilc ...	PO Ilc ...	...	FO IlO..	PO IlO...	A big branchy tree quite healthy except for 2 cankered lower branches.
XIX	1'·2	R Il ...	R Il ...	PO ...	PO R Il	P R Ilc	...	D ...	D ...	
XX	1'·5	R Il ...	R Il ...	R P2 ...	R Il P2	R Ilc P2	...	R2 I2 P2	R2 I2 P2	
XXI	1'·4	P2 Ilc ...	P2 Ilc ...	P2 ...	P2 Il RO	P2 Il RO	...	P Il2 RCO	D ...	A healthy bushy tree with good deal of fungus but no resin till 21-9-19.
XXII	1'·1	P R Il ...	P R Il ...	P2 R ...	P R Il2 ...	P R I ...	D ...	D ...	D ...	= 53 .
XXIII	1'·6	P2 R ...	P2 ...	P2 ...	P2 R I ...	P2 R I ...	D ...	D ...	D ...	= 54
XXIV	1'·10	PO Il ...	PO Il R	PO Il2R	P2 Il2 ...	...	...	P2 I2 R2	P2 I2 R2	One lower branch only cankered.
XXV	...	...	...	P2 R ...	D ...	D ...	D ...	D ...	D ...	
XXVI	...	...	...	P2 ...	D ...	D ...	D ...	D ...	D ...	

XI	Girth	1/8/18	11/10/18	19/5/19	21/9/19	1/8/20	20/4/21	20/6/21	19/7/21	REMARKS.
XXVII	...	...	...	P2 CO ...	D ...	D ...	D ...	D ...	D ...	
XXVIII	...	...	...	PO ...	P R2 ...	D ...	D ...	D ...	D ...	
XXIX	...	...	...	P2 R2 ...	D ...	D ...	D ..	D ...	D ...	When felled, full of *Cryptorrynchus* larvæ and pupæ in bole and *Polygraphus* larvæ in crown and branches.
XXX	...	...	...	P2 R2 ...	D ...	D ...	D ...	D ...	D ...	
XXXI	...	...	...	PO ...	PO ...	P I RO...	P I R ...	P Il2 R2	P I2 R2 CO	= 52
XXXII	...	...	...	P2 R2 ..	D ...	D ...	D ...	D ...	D ..	= 48
XXXIII	...	...	...	P2 ...	P2 R2 ...	P2 R2 Icl2	D ...	D ...	D ...	

N = Normally healthy.
R = Fresh resin bleeding.
P = *Peridermium* infected: shown present once it has been noted. Lost in no case in 29-4-21.
I = Insects: c = Coleoptera: l = Lepidoptera.
D = Dead.
L = Lopping injury (fresh) noted.
C = Crown unhealthy.
O = Defect present to slight extent only.
2 = Defect present to considerable extent.

NEW INDIAN SPECIES OF FOREST IMPORTANCE.

PART 5.

(*Continued from* Indian Forester, *Vol. XLV* (1919) *pp.* 388—392.)

393 species have already been enumerated in the previous parts of this list and with 157 in the present part the total now comes to 550 species.

Acacia Campbellii, Arn., *Leguminosæ*, (Gamble's Madras Flora, III, p. 426), S. India.

A. Roxburghii, W. & A., *Leguminosæ*, (l. c., p. 426), S. India.

Aerua pseudo-tomentosa, Blatt. and Hallberg, *Amarantaceæ*, (Jour. Bom. Nat. Hist. Soc., Vol. XXVI (1919), p. 817), Jodhpur, etc.

Agapetes marginata, Dunn, *Vacciniaceæ*, (Kew Bull., 1920, p. 133), E. Himalaya.

5. **A. Moorei,** Heml., *Vacciniaceæ*, (Bot., Mag., 7928), Sikkim,

A. nutans, Dunn, *Vacciniaceæ*, (Kew Bull., 1920, p. 134), E. Himalaya.

Aglaia Haslettiana, Haines, *Meliaceæ*, (Jour. As. Soc., Beng., 1919, p. 312), Orissa.

Andrachne emicans, Dunn, *Euphorbiaceæ*, (Kew Bull., 1920, p. 210), E. Himalaya.

Anogeissus rotundifolia, Blatt. and Hallberg, *Combretaceæ* (Jour. Bom. Nat. Hist. Soc., Vol. XXVI (1919), p. 525), Kailana near Jodhpur.

10. **Ardisia Blatteri,** Gamble, *Myrsinaceæ*, (Kew Bull. 1921, p. 121), S. India.

Aspidopterys Hutchinsonii, Haines, *Malpighiaceæ*, (Kew Bull., 1920, p. 66), Orissa.

Atylosia cajanifolia, Haines, *Leguminosæ*, (Jour. As. Soc., Beng., 1919, p. 312), Forests of Orissa.

Bassia Bourdillonii, Gamble, *Sapotaceæ*, (Kew Bull., 1921, p. 121), S. India.

Berberis Hookeri, Lem., *Berberidaceæ*, (Bull. Herb. Boiss. 2nd series, Vol. VIII (1908), p. 196), Sikkim, Himalaya.

15. **B. levis**, Franchet, *Berberidaceæ*, (l. c., p. 198), Upper Burma, Shan Hills.

B. Osmastonii, Dunn, *Berberidaceæ*, (Kew Bull., 1920, p. 335), Central Himalaya.

B. pseudumbellata, Parker, *Berberidaceæ*, (Kew Bull., 1921, p. 118), N.-W. Himalaya.

Biophytum insigne, Gamble, *Geraniaceæ*, (Kew Bull., 1921, p. 216), S. India.

Brassaiopsis magnifica, Dunn, *Araliaceæ*, (l. c. 1920, p. 132), E. Himalaya.

20 **Bridelia verrūcosa**, Haines, *Euphorbiaceæ*, (Jour. Bot., Vol. LIX, p. 189), Lower Himalaya, Higher Siwaliks and Chota Nagpur.

Bruguiera Hainesii, C. G. Rogers, *Rhizophoraceæ*, (Kew Bull., 1919, p. 225), Burma.

Buddleia candida, Dunn, *Loganiaceæ*, (l. c., 1920, p. 134), E. Himalaya.

Caragana Hoplites, Dunn, *Leguminosæ*, (l. c., p. 338), N. Garhwal.

Casearia varians Bedd, *Samydaceæ*, (Flora of Madras, III, p. 521), S. India.

25. **Cassia hirsuta**, Linn., *Leguminosæ*, (Flora of Madras, III, p. 401), Naturalised in S. India, Trop. America.

C. holosericea, Fresen, *Leguminosæ*, (Cooke Fl. Bom., P 1903, p. 422), Sind, Hyderabad.

C. nigricans, Vahl., *Leguminosæ*, (Mad. Fl., Pt. III, p. 403), W. Coast.

Cayratia japonica, Gagnep, *Vitaceæ*, (l. c., Pt. II, p. 237), W. Ghats.

C. tenuifolia, Gagnep, *Vitaceæ*, (l. c., p. 237), W. Ghats.

30. **Coffea crassifolia**, Gamble, *Rubiaceæ*, (Kew Bull., *1920*, p. 248), S. India.

Connarus sclerocarpus, Schellenab, *Connaraceæ*, (Flora of Madras., II, p. 273), S. India.

Cotoneaster obovata, Wall. Mss. ex Dunn, *Rosaceæ*, (Kew Bull., 1921, p. 119), N.-E. Punjab.

Cytisus albus, Link, *Leguminosæ*, (Flora of Madras, II, p. 301), Nat. on the Nilghiris, Algéria.

C. monspessulanus, Linn., *Leguminosæ*, (l c., p. 301), Naturalised on the Nilghiris, S. Europe.

35. **Desmodium wynaadense**, Bedd. Mss. ex Gamble, *Leguminosæ*, (Kew Bull., 1919, p. 223), S. India.

Diospyros impressa, Dunn, et R. Williams, *Ebenaceæ*, (l. c., 1920, p. 342), Burma.

Dioticarpus, Dunn, Gen. Nov., *Dipterocarpaceæ*, (l. c., p. 337).

D. Barryi, Dunn, *Dipterocarpaceæ*, (l. c., p. 337), Seem Journ. Bot. (*1870*), p. 383, South India.

Dolichandrone serrulata, *Bignoniaceæ*, (l. c., 1919, p. 306), Burma.

40. **Elatostema MacIntyrei,** Dunn, *Urticaceæ*, (l. c., 1920, p. 210), E. Himalaya.

Emilia ramulosa, Gamble, *Compositæ*, (l. c., 1921, p. 120), S. India.

Erythrina glabrescens, Parker, *Leguminosæ*, (Ind. For., Vol. XLVI, 1920, p. 647), Ravi and Sully Valleys at 2,000'—4,000' and similar places in U. P.

E. myscrensis, Gamble, *Leguminosæ*, (Kew Bull., 1919, p. 222), S. India.

Eugenia aborensis, Dunn, *Myrtaceae* (l. c., 1920, p. 109), E. Himalaya.

45. **Fagonia spinosissima,** *Blatt.* and Hall., *Zygophyllaceæ*, (Jour. Ind. Bot., Vol. I, p. 39), Baluchistan.

Gaillonia macrantha, Blatt. and Hall., *Rubiaceæ*, (l. c., p. 170), Baluchistan.

Glossocardia setosa, Blatter and Hallberg, *Compositæ*, (Jour. Bom. Nat. Hist. Soc., Vol. XXVI (1919), p. 536, Jodhpur.

Helichrysum perlanigerum Gamble, *Compositæ*, (Kew Bull., 1920, p. 341), S. India.

Hoya burmanica, Rolfe, *Asclepiadaceæ*, (l. c., p. 343), Burma.

50. **Hugonia Belli,** L. J. Sedgwick, *Linaceæ*, (Ind. For., Vol. XLVI, 1920, p. 424), Coorg.

Hypericum Gaitii, Haines, *Hypericaceæ*, (Jour. As. Soc., Beng., 1919, p. 311), Sub-tropical India.

Indigofera Barberi, Gamble, *Leguminosæ*, (Kew Bull., 1919, p. 222), S. India.

I. longiracemosa, Boivin, *Leguminosæ*, (Prain and E. Baker in Jour. Bot., 1902, p. 144), S. India.

I. paucifolioides, Blatt. and Hall., *Leguminosæ*, (Jour. Ind. Bot., Vol. I, p. 132), Baluchistan.

55. **I. cedrorum,** Dunn, *Leguminosæ*, (Kew Bull. 1920, p. 337), Chamba State.

Ionidium travancoricum, Bedd., *Violaceæ* (Bedd. Icon. (1874), t. 230), S. India.

Ixora Lawsoni, Gamble, *Rubiaceæ*, (Kew Bull. 1920, p. 247), S. India.

I. monticola, Gamble, *Rubiaceæ*, (l. c., p. 246), S. India, etc.

I. Saulierei, Gamble, *Rubiaceæ*, (l. c., p. 247), S. India.

60. **Jambosa Mundagam,** Gamble, *Myrtaceæ* (Mad. Fl., Pt. III, p. 473), W. Ghats.

Jasminum Parkeri, Dunn, *Oleaceæ*, (Kew Bull., 1920, p. 69), Chamba State.

Jussiaea fissendocarpa, Haines, *Onagraceæ*, (Jour. Ast., Soc., Bengal, 1919, p. 313), Northern Purnea and Nepal, Perak.

Lasianthus cinereus, Gamble, *Rubiaceæ*, (Kew Bull., 1920, p. 249), S. India.

Lasiococca Comberi, Haines, *Euphorbiaceæ*, (l. c., p. 70), Orissa.

65. **Leptodermis Parkeri,** Dunn, *Rubiaceæ*, (l. c., p. 206), Punjab Himalaya.

Linociera Parkinsonii, Hutchinson, *Oleaceæ*, (l. c., 1919, p. 229), Andaman Islands, etc.

Memecylon flavescens, Gamble, *Melastomaceæ* l. c., 1919, p. 226), S. India.

M. Lawsoni, Gamble *Melastomaceæ*, (l. c., p. 226), S. India.

M. Lushingtonii, Gamble, *Melastomaceæ*, (l. c., p. 227), S. India.

70. **M. madgolense**, Gamble, *Melastomaceæ*, (l. c., p. 227), S. India.

M. Sisparense, Gamble, *Melastomaceæ*, (l. c., p. 227), S. India.

Miliusa dolichantha, Craib, *Anonaceæ*, (l. c., 1920, p. 108), E. Himalaya.

Mimosa Barberi, Gamble, *Leguminosæ*, (l. c., p. 5), N and Cent. India.

M. himalayana, Gamble, *Leguminosæ*, (l. c., p. 4), N. and Cent. India.

75. **M. Prainiana**, Gamble, *Leguminosæ*, (l. c., p. 5), Cent., West and South India.

Morinda reticulata, Gamble, *Rubiaceæ*, (l. c., p. 248), S. India.

Noltea africana, Harv. and Sond., *Rhamnaceæ*, (Flora of Madras, II, p. 225), Naturalised on the Nilghiris, S. Africa.

Nothopegia Beddomei, Gamble, *Anacardiaceæ*, (Mad. Fl., Pt., II, p. 265), W. Ghats.

N. Dalzellii, Gamble, *Anacardiaceæ*, (l. c., p. 265), W. Ghats.

80. **Oldenlandia anamalayana**, Gamble, *Rubiaceæ*, (Kew Bull., 1920, p. 67), S. India.

O. Barberi, Gamble, *Rubiaceæ*, (l. c, p. 68), S. India.

O. Bourdillonii, Gamble, *Rubiaceæ* (l. c., 1919, p. 404), S. India.

O. eualata, Gamble, *Rubiaceæ*, (l. c., p. 404), S. India.

O. Ramarowii, Gamble, *Rubiaceæ*, (l. c., p. 405), S. India.

85. **O. villosostipulata**, Gamble, *Rubiaceæ*, (l. c., p. 405), S. India.

O. wynaadensis, Gamble, *Rubiaceæ*, (l. c., p. 405), S. India.

Ophiorrhiza Barberi, Gamble, *Rubiaceæ*, (l. c., p. 406), S. India.

O. codyensis, Gamble, *Rubiaceæ*, (l. c, p. 406), S. India.

O. heterostyla, Dunn, *Rubiaceæ*, (l. c., 1920, p. 133), E. Himalaya.

90. **O. pykarensis**, Gamble, *Rubiaceæ*, (l. c., 1919, p. 407), S. India.

Osbeckia sublævis, Cogn., *Melastomaceæ*, (Mad. Fl., Pt. III, p. 492), W. Ghats.

O. travancorica, Bedd. ex Gamble, *Melastomaceæ*, (Kew Bull., 1919, p. 404), S. India.

Passiflora calcarata, Mast., *Passifloraceæ*, (Flora of Madras, III, p. 524), Naturalised on the Nilghiris, Madagascar.

P. edulis, Sims, *Passifloraceæ*, (l. c., p. 524), Naturalised in S. India, Brazil.

95. **Potentilla sericophylla**, Parker, *Rosaceæ*, (Kew. Bull., 1921, p. 217), N.-W. India.

Psychotria aborensis, Dunn, *Rubiaceæ*, (Kew Bull., 1920, p. 133), E. Himalaya.

P. Barberi, Gamble, *Rubiaceæ*, (l. c., p. 248), S. India.

P. globicephala, Gamble, *Rubiaceæ*, (l. c., p. 249), S. India.

Pulicaria rajputanæ, Blatt. and Hallberg, *Compositæ*, (Jour. Bom. Nat. Hist. Soc., Vol. XXVI (1919), p. 535), Jodhpur.

100. **Pyrus cordata**, Desv. Obs. Pl. Anj. 152, *Rosaceæ*, (Jour. Ind. Bot., Vol. I, p. 137), Baluchistan.

Reaumuria panjgurica, Blatt. and Hall., *Tamaricaceæ*, (Jour. Ind. Bot., Vol. I, p. 87), Baluchistan.

R. Stocksii, Boiss. Fl. Or., I, 761, *Tamaricaceæ*, (l. c., p. 86), Baluchistan.

R. hypericoides, Willd., Sp. II, 1250, *Tamaricaceæ*, (l. c., p. 87), Baluchistan.

Rhamnus punctata, Boiss. Diag., Ser. 1, II, 4, *Rhamnaceæ*, (l. c., p. 128), Baluchistan.

105. **R. spathulæfolia**, F. and M. Ind. Seem. Hort. Petro. IV, 46, *Rhamnaceæ*, (l. c., p. 129), Baluchistan.

R. pentapomica, Parker, *Rhamnaceæ*, (Kew Bull., 1921, p. 216), N.-W. India, Baluchistan, Salt Range and outer Himalaya as far east as Garhwal.

R. prostrata, Jacquem, Mss. ex Parker, *Rhamnaceæ*, (Kew Bull., 1921, p. 217), N.-W. Himalaya, Garhwal, Kunawar, Spiti, Padar, Ladakh, etc.

Rhinacanthus grandiflorus, Dunn, *Acanthaceæ*, (Kew Bull., 1920, p. 135), E. Himalaya.

Rosa (cinnamomea) Saundersiae, Rolfe, *Rosaceæ*, (l. c., 1919, p 224), N.-W. India, Murree, etc.

110. **Rubus Burkillii,** Rolfe, *Rosaceæ*, (l. c., 1920, p. 109), E. Himalaya.

R. (Idæobatus) chambica, Rolfe, *Rosaceæ*, (l. c., p. 132), Chamba State, Pangi, etc.

R. Fairholmianus, Gardn., *Rosaceæ*, (Gamble, Madras Flora, III, p. 441), W. Ghats.

R. fulvus, Focke, *Rosaceæ*, (Mad. Fl., Pt. III, p. 441), W. Ghats.

R. Gardenerianus, O. Kze, *Rosaceæ*, (l. c., p. 441), W. Ghats.

115. **R. micropetalus**, Gardn., *Rosaceæ*, (Gamble's Madras Flora, III, p. 441), S. India.

R. Wightii, Gamble, *Rosaceæ*, (l. c., p. 440), Sivagiri Hills, Tinnevelly.

Sadiria Boweri, Dunn, *Myrsinaceæ*, (Kew Bull., 1920, p. 111), E. Himalaya.

Sarcococca vagans, Stapf., *Buxaceæ*, (l. c., 1919, p. 230), Burma.

Schefflera bengalensis, Gamble, *Araliaceæ*, (l. c., p. 229), N. India, Mountains of Sikkim, Bhutan, Khasia Hills and Sylhet, U. Burma.

120 **S. Bourdillonii,** Gamble, *Araliaceæ*, (l. c., p. 228), S. India.

Sonerila pulneyensis, Gamble, *Melastomaceæ*, (l. c., p. 226), S. India.

S. Rheedii, W. and A., *Melastomaceæ*, (Flora of Madras, III, p. 500), S. India.

Spiræa hypoleuca, Dunn, *Rosaceæ*, (Kew Bull., 1921, p. 119), Garhwal.

Spiræa Zabeliana, Schneider, *Rosaceæ*, (Bull., Herb, Boiss. Ser. II, Vol. V, p. 343), Kumaon Garhwal.

125. **Strobilanthes aborensis,** Dunn, *Acanthaceæ*, (Kew Bull., 1920, p. 208), E. Himalaya.

S. Burkilli, Dunn, *Acanthaceæ*, (l. c., p. 208), E. Himalaya.

S. tenax, Dunn, *Acanthaceæ*, (l. c., p. 209), E. Himalaya.

Symplocos Barberi, Gamble, *Styraceæ*, (Kew Bull., 1921, p. 219), S. India.

Syzygium chavaran, Gamble, *Myrtaceæ*, (Mad. Fl., Pt. III, p. 480), W. Ghats.

130. **S. Fergusoni,** Gamble, *Myrtaceæ*, (Kew Bull., 1920, p. 52), W. Ghats.

S. olivifolium, Gamble, *Myrtaceæ*, (l. c., p. 52), W. Ghats.

Tamarix laxa, Willd., *Tamaricaceæ*, (Jour. Ind. Bot., Vol. I, p. 85), Baluchistan.

Tamarix longepedunculata, Blatt. and Hall., *Tamaricaceæ*, (Jour. Ind. Bot., Vol. I, p. 86), Baluchistan.

Tamarix Troupii, Hole, *Tamaricaceæ*, (Ind. For., Vol. XLV, 1919, p. 248), U. P., Bengal.

135. **Tephrosia Barberi,** J. R. Drum., *Leguminosæ*, (Mad. Fl., Pt. II, p. 320), S. Carnatic.

T. canarensis, J. R. Drum., *Leguminosæ*, (l. c., p. 319), W. Ghats.

T. Hamiltonii, J. R. Drum., *Leguminosæ*, (l. c., p 320), Deccan.

T. Roxburghiana, J. R. Drum., *Leguminosæ*, (l. c., p. 319), N. Circars.

T. wynaadensis, J. R. Drum., *Leguminosæ*, (l. c., p. 311), W. Ghats.

140. **Terminalia Gella,** Dalz., *Combretaceæ*, (Flora of Madras, III, p. 464), S. India.

Tetrastigma alcicorne, Haines, *Vitaceæ*, (Kew Bull., 1920, p. 67), Champaran near the Nepal hills.

Teucrium Toppinii, Dunn, et R. Williams, *Labiatæ*, (Kew Bull., 1921, p. 122), N.-W. India.

Trachelospermum anceps, Dunn, et R. Williams *Apocynaceæ*, (l. c., 1920, p. 343), Lower Burma.

Ulex europæus, Linn., *Leguminosæ*, (Flora of Madras, II, p. 301), Naturalised on the Nilghiris, W. Europe.

145. **Vatica Shingkeng,** Dunn, *Dipterocarpaceæ*, (Kew Bull., *1920, p. 108), E. Himalaya.*

Vernonia anamallica, Bedd. Mss. (Herb. Mad.) ex. Gamble, *Compositæ*, (l. c., p. 339), S. India.

Vernonia Bourdillonii, Gamble, *Compositæ*, (l. c., p. 339), S. India.

V. gossypina, Gamble, *Compositæ*, (l. c., p. 340), S. India.

V Heynei, Bedd. Mss. (in Herb. Mad.) ex Gamble, *Compositæ*, (l. c., p. 340), S. India.

150 **V. multibracteata,** Gamble, *Compositæ*, (l c., p. 340), S. India.

V. pulneyensis, Gamble, *Compositæ*, (l. c., p. 341), S. India.

V. **Shevaroyensis**, Gamble, *Compositæ*, (l. c., p. 341), S. India.

Vigna Bourneæ, Gamble, *Leguminosæ*, (l. c., p. 224), S. India.

Xanthopyllum Burkilli, Drum., et Dunn, *Polygalaceæ*, (l. c, 1920, p. 245), E. Himalaya.

155 **Zygophyllum eurypterum**, Boiss and Bushe Aufz. 49, *Zygophyllaceæ*, (Jour. Ind. Bot., Vol. I, p. 90), Baluchistan.

Z. trialatum, Blatt. and Hall., *Zygophyllaceæ*, (l. c., p. 90), Baluchistan.

127. **Z. fabago**, L., *Zygophyllaceæ*, (l. c., p. 91), Baluchistan.

R. N. PARKER,
Systematic Forest Botanist,
and
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HENRY S. GRAVES RETURNS TO THE YALE SCHOOL OF FORESTRY.

It has recently been announced that plans long under consideration by Dean James W. Toumey of the Yale School of Forestry are now consummated in the arrangement whereby Colonel Henry S. Graves, formerly Chief Forester of the United States, is to return to his former position as Dean of the School. Mr. Toumey desires to resume his more purely scientific work and Mr. Graves, in view of the widening opportunities afforded to the School by its recent developments, is returning enthusiastically to his old post.

Coming coincidentally with the announcement that a further substantial increase representing the income on a quarter of a million dollars has been added to the School's resources, and

that three hundred thousand dollars have recently been received for the erection and maintenance of a School of Forestry building, the news that such a conspicuous forester as Mr. Graves has been called to the faculty of the Yale School will generally be regarded as significant. The fact that Mr. Graves recently declined an offer of the position of Conservation Commissioner of the State of New York on the ground that the Yale School of Forestry offer, then under consideration, promised the greatest field for the national educational work in connection with forests and other natural resources in which he has been engaged since his resignation from Government service, will also be regarded as a significant circumstance. It is believed that the national eminence and international reputation of Mr. Graves will bring a degree of prestige which will directly influence the future growth of the Yale School.

In this connection it is announced that the Trustees of the estate of John W. Sterling have decided to establish in the University a fifth Sterling Professorship, to be known as the Sterling Professorship of Forestry. The first incumbent of this Sterling Professorship will be Professor Henry S. Graves, the Dean elect of the School of Forestry.

Mr. Toumey, whose retirement as Dean is a voluntary act, desires relief from executive duties in order to devote himself to more intensive work in silviculture. He has been connected with the Yale School of Forestry since its foundation in 1900, when he became Assistant Professor of Forestry. He was advanced to full professorial rank in 1903, and was assigned to the Morris K. Jesup Professorship of Silviculture when this chair was established in 1909. It is an interesting fact that Mr. Graves was the first Director of the School of Forestry, and retained that position until 1909. Mr. Toumey was Acting Director during the years 1909—1911, since when he has served as the administrative head of the School. Under Dean Toumey Yale's youngest School has attained marked success, extending its educational scope, adding to its equipment, sending its graduates into every form of service in the widening field of Forestry, and assuming

leadership among the forest schools in this country. No other school of Yale University has enjoyed a more remarkable development than has the School of Forestry under the administration of Dean Toumey.

The new Yale Dean of Forestry was one of the Pioneers in the Forestry movement. He first came into prominence during the period of his office as Director of the Yale School of Forestry. In 1910 he was selected by President Taft to succeed Gifford Pinchot as Chief Forester in charge of the Forest Service in the United States Department of Agriculture. Later, in 1920, he resigned to devote himself to the private practice of forestry, opening offices in Washington, D. C.

In 1917 Mr. Graves was commissioned a Major in the Corps of Engineers and was sent to France to prepare for the work of the forestry troops then being organised to operate the French forests for the purpose of securing lumber and other material needed for the American army. He was later promoted to a Lieutenant-Colonelcy in the Tenth Engineers.

Mr. Graves is a member of the Board of Management of the Washington Academy of Sciences, Vice-President of the Section of Social Economic Sciences of the American Association for the Advancement of Science, a member of the Division of States Relations in the National Research Council, a member of the Joint Committee on Natural Resources of the National Academy of Science, National Research Council and the American Association, an honorary member of the Royal English and the Royal Scottish Arboricultural Societies, a member of the Sociètè Forestiere de Franche Comte d'Belfort, member of the Society of American Military Engineers, and a member and officer in numerous societies and organisations for the advancement of Forestry and kindred subjects.

LAYS OF THE WESTERN GHATS.

VI.—THE CHANGE.

Three months have gone since the Sun last shone
On my camp in the upland here,
The grass was rank, the jungle dank,
And the wet mist hovered near.

But a change has come o'er the woodland face
For one and a single reason—
The short cold weather has worn aspace
To return no more for a season.

No longer the sheen on canopy green
No water to flush the rills,
The Sun bakes down on a world of brown
And a heat haze dims the hills.

And now leaf-bare are the saplings spare
That crowded the low wood all ;
And trees are stunted and sparsely spread
That before looked close and tall.

The soft cool breeze that stirred the trees
Has gone for a scorching blast ;
And where grasses sweet entwined the feet
The dust-storm scurries past.

But not for the heat in his jungle beat
May the Forester rest or stop,
For these are the days when the firewatch stays
On the lonely mountain top.

From March till June he must toil through noon
While other creatures rest
To choose the trees as his craft decrees
For now can he find them best.

And see him creep o'er the pathless steep
That knows nor stop nor turning
With water-sack on a petulant back
And a throat like a lime-kiln burning.

But here and there through the forest bare
Sweet-scented breezes blow
As the blossom breaks to the call that wakes
And the first new leaflets show.

For the trees have scent that foretells advent
Of the kindly monsoon rain
And a magic tap leads up the sap
That will make them green again.

And so to the jungle worker come
Home memories fresh and clean
For the tree's new Youth but points the truth
That the heart that loves, keeps green.

And hope rides high in his Sun-scorched eye
As his wayward fancies roam
And musings fond cement the bond
Twixt hearts out here, and Home.

GEM.

SILVICULTURAL NOTE.

Storing Sal Seed.—It is believed that the following method of storing Sal seed may help to solve a difficult problem. On the 22nd June 1921, 1,200 seeds, freshly collected, were sown on 3 inches of saw-dust on a stone verandah and watered twice daily. Germination commenced 3 days later and 100 per cent. germination was obtained in 7 days. This could be done on the floor of any forest guard house or out-building and takes very little space. The seeds were half covered.

The plants were left on the saw-dust for another 10 days and on July 9th were removed, together with the saw-dust, in baskets, to the experimental garden. At the time of removal

they were from 1″ to 7″ high and had roots from 1½″ to 2½″ in length. The period of transition was approximately four hours and they were then planted in pits 5 ft. apart and 18″ in diameter : two plants to each pit. They immediately established themselves without any preliminary drooping and have not looked back since. They have so far not been affected by frost, which has been very slight this cold weather and it only remains to be seen whether they will be affected by drought during the hot weather. So far the experiment has been a success and if the plants survive in the hot weather a fuller note will be written for publication. The plants are now on the average 5″ to 6″ high.

It is to be hoped that others will carry out experiments on the above lines as this method may help to maintain the vitality of Sal seed between the period of seed fall and the burst of the monsoon.

REVIEWS AND EXTRACTS.

REPORT ON THE FORESTS DEPARTMENT OF WESTERN AUSTRALIA FOR THE YEAR ENDED 30TH JUNE 1921.

The first point about this report that strikes one accustomed to similar publications in India is the fact that it is impossible to ascertain with any certainty what the area under the control of the department is.

Only 45,028 acres are State forests, or, in the words of the Conservator of Forests, Mr. C. E. Lane-Poole, "forests dedicated for all time to the object of growing timber."

The area yielding forest produce and under some sort of State control is far larger, as can be seen from the list of concessions and leases, etc. One for the removal of tan barks covers 4,400,000 acres. The aggregate area is shown as 7,116,128 acres but this is not a dependable guide as one lease covering 70,000 square miles, for the removal of sandalwood is omitted without explanation. Further there is nothing to show whether the leases overlap or not.

These concessions, leases, etc., consist of 7 categories, as shown in the subjacent statement, which also gives the total number of each kind in force during the year under report and their aggregate areas:—

3	Timber Concessions	375,233	acres
22	Timber Leases	215,081	"
28	Sawmill Permits	788,414	"
25	Hewing Permits	29,729	"
41	Sawmilling Permits	192,461	"
31	Firewood Permits	66,004	"
13	Miscellaneous Permits	5,449,206	"
163		7,116,128	"

In the case of concessions and leases rent is paid on an acreage basis, whereas for permits royalty is levied on the quantities removed. For concessions the rental is very low, averaging

½d. per acre, and the power of making regulations to restrict exploitation is so limited that none of any importance can be passed. Leases are at a somewhat higher rental, averaging 7½d. per acre, and the State is able to protect immature growth. The permits are sold by auction and in the case of timber, ranging up to 2d. per cubic foot, "there is complete power to make any regulations whatever" including raising the rate where this is clearly justified by sales in the open market. It is not practicable, however, to raise the rates materially at present as It would place permit-holders in so unfavourable a position in competition with concessionaires and lessees as to force them out of the market. Improvement in this direction cannot be looked for until all the existing agreements fall in This will not occur until 1929 and there is provision for a possible further extension. A recent ruling indicates that such extension is likely. The Conservator writes: "The decision thus arrived at will have the effect of definitely postponing the inauguration of sound forestry methods until the expiration of the period of the larger part of the leases, that is about 1931. At the present rate of cutting, and it will be clear from the above that it is not possible to regulate the cutting, there will be little or no virgin forest left in Western Australia by the time these rights expire. The export trade will be reduced to a minimum, if it has not already vanished and the revenue derived from the forests will be so small that it will be entirely insignificant compared with the sum required and which must be provided from the pocket of the general tax-payer of the day, to meet the enormous cost of repairing the damage done to the State forests by the concentrated timber mining encouraged by successive governments since the eighties. How near the State is to the exhaustion of its forests is shown by the results of the forest classification. There remains to-day only 350,000 acres of virgin jarrah forest, and practically all of it is already granted to sawmillers and will be cut out in ten years time.'

It seems clear that vested interests are in a position to ractise the gentle and profitable art of 'wirepulling' and the

report has several laments on the situation of which the following is an example:—

The Railway department finds difficulty in securing its requirements in sleepers, calculated at about 500,000 per year, at a reasonable rate, though it has its own sawmill that cuts 200,000 at 1*s*. 6*d*. per foot cube from forests reserved for railway purposes which cannot meet a greater demand. Owing to the export trade sleepers cannot be procured in the open market at less than 3*s*. per cubic foot. Negotiations with private firms were entered upon to try and get all those dealing in sleepers to share the supply of the 300,000 needed at a maximum rate of 2*s*. 5*d*. per cubic foot but without success. The Conservator concludes:—

"*The State now finds itself in the very extraordinary situation* of having to watch the destruction of the small amount of virgin jarrah country by sawmillers for the supply of sleepers for *overseas markets, a business which means the prostitution of* one of the finest general purpose hardwoods to the most debased use, and at the same time the State is unable to obtain 300,000 sleepers to maintain her railway lines, except at a price which on the Railway department's own mill figures work out at a profit of 100 per cent."

Sandalwood is a source of considerable revenue and is extracted on permits on payment of a royalty which was raised during the year under report from 5*s*. to £2 per ton. From one of the forms in the appendix it would appear that 6,953 tons were obtained from crown lands, but this figure must be accepted with reservation since another form gives the total royalty collected for sandalwood as £17,653, which at £2 represents over 8,800 tons. Even this latter figure must fall short of the actual removals for a note in the body of the report tells us that part of the extraction of the year was paid for at the old rate of 5*s*.

It is well known that the sandalwood of Australia (*Santalum cygnorum*) is considerably inferior to that of India and this is reflected by the fact that the price of the former (mostly exported to China) in 1920 stood at £36 per ton, which, at the then rate

of exchange, did not exceed Rs. 350, and even at present rates is under Rs. 600, whereas Indian sandal fetched five times that sum. On the other hand, the Australian sandal reaches maturity at 25 years. It is as much liked by browsing animals as its Indian congener and the absence of young natural growth is ascribed by Mr. Lane-Poole to this fact. He urges planting on a large scale in consequence.

The Conservator considers that the royalty on sandal as well as on other timber is too low and adumbrates considerable increases in the near future as the "prices obtained by private owners have been everywhere in excess of the prescribed royalty charged by the department, and in some cases have been twenty times that royalty."

A salutary act provides that only two-fifths of the net surplus revenue is paid into the treasury and three-fifths becomes available for forest expenditure. This credit does not lapse with the financial year but is cumulative. In 1920-21 the gross revenue was £75,469 and the total expenditure £19,159 (shown as only £16,128-9-11 in the financial statement). The net surplus therefore was £56,310 and the forest share £33,786. A balance of £22,876 was carried forward from the previous year so that a total of £56,662 was available for the current year.

It would appear that this act was only introduced in 1918 as it is remarked that from 1895, the year of the inception of the department, to 1918 "the whole revenue went into the treasury and no money whatever was spent on the Jarrah and Karri forests......"

Since the inception of the department an aggregate gross revenue of £814,254-5-0 has been obtained and £194,365-10-6 expended, leaving a surplus of £619,888-14-6. Or for the 26½ years the annual averages are respectively £30,725; £7,335 and £23,390, in round figures.

The chief timber forests are the Jarrah and Karri areas. The present condition of both appears to be deplorable owing to years of uncontrolled cutting and burning. Valuation surveys made by the recently appointed Assistant Working Plans Officer

show that on 40,000 acres of cut-over Jarrah country there is an average of only 2·45 sound and 21·2 useless saplings under 10 inches diameter per acre.

The Karri forests are somewhat better as fires there occur usually at intervals of not less than 8 years as against three to four years in the Jarrah forests. This longer interval allows many saplings to attain a height that enables them to escape being burnt back. The principal danger in the Karri area is due to the density of the crop and the damage to immature growth done during felling. No less than 30,000 cubic feet per acre have beee recorded in some exploitations and the average volume of a Karri tree is said to be 700 cubic feet of timber. The felling of such large quantities plays havoc among the young growth.

Complaint is also made of the wasteful method of felling. "The invention of a portable steel staging has greatly increased the waste of timber through the practice of the fellers setting up the staging on any pretext and cutting the tree at heights which sometimes reach ten feet from the ground. No less than 250 cubic feet to the acre of sound timber is left behind in this manner.

The Tuart (*Eucalyptus gomphocephala*) forests are in a bad way owing to "the entire absence of regeneration for the past 50 years due to grazing and fires."

As will have been gathered, fire is held to be the most serious danger that menaces the forest; consequently, elaborate protective measures are contemplated. The most important of the State forests are to be divided into 500 acre blocks and a fire-line one chain wide eventually will be cleared round each. It is not expected that these lines will prevent all fires from crossing but they will serve for counterfiring and as bases from which to beat out the smaller conflagrations.

Fire lookouts are being constructed in prominent situations and are to be provided with telescopes mounted on a graduated disc and will be connected with telephones. It will be possible then to locate a fire rapidly and to communicate the exact location at a very early stage.

The Conservator closes this section with the remark that "Fire rangers may be necessary for a year or two until popular education and spark-arresters on locomotives eliminate the two most frequent causes of fires."

The education has apparently begun since it is reported that "the Collie townspeople have formed a society whose objects are mainly to prevent forest fires."

Publicity is not neglected; leaflets and bulletins on specific subjects are issued and are in considerable demand. With regard to education it is stated that "In the schools under the Education Department forestry is a subject that is receiving a gratifying share of attention and one result of this was that many hundreds of scholars called at the department in order to obtain literature dealing with the matter."

It would be well if these measures were also adopted in this country as, indeed, some of us have already urged.

With regard to grazing we are informed, "on account of the close association of grazing with bush fires......it has been necessary to control the grazing of cows... ...It will surprise no one in this country to find this sentence followed by the remark "Local residents at first strongly resented interference with long standing privileges," alas! that we cannot echo the sequel from Indian experience,"......but the saneness of the department's policy and the importance of forestry were quickly recognised and local support is now assured."

The grazing control is to be effected by "fencing of external boundaries and a system of annual leases of grazing rights over specified areas is to be introduced. Water will be provided in all the paddocks and the leases sold by auction at a given time each year."

In one section arrangements have been made to run in and impound the semi-wild and tame horses.

A start has been made with working plans since the services of a trained assistant have been secured. It will interest those forestry students who were at Oxford in the first half of 1919 to know that this is S. L. Kessell, the young Australian, who

took his diploma with 'distinction' in September of that year and joined the Western Australia Forest Department early in 1920. At the time of the report he had already prepared three valuable plans for the most important of the State forests. The Jarrah and Tuart forests are to be worked under the group selection system. In the coal-fields (Collie) area, however, clear felling and replanting with Jarrah and other species according to locality is prescribed.

It is estimated that "the land in the South-West division of the State which will yield a better return under timber than under field crop amounts to 3,000,000 acres." It is proposed to divide this area into 6 districts, each under the control of a professional forest officer. Each district will be subdivided into 10 Ranges of 50,000 acres with a resident forester, and these again into 100 compartments of 500 acres, which "will form the unit permanent division within the forest."

Research is not being overlooked. A tannin survey is in progress and 80 samples of materials have already been examined. Woods are being tested for paper making qualities. A drying kiln has been erected and a start made with Karri, the enquiry on Jarrah wood having been completed. Finally experimental work on the preservation of timber is also being undertaken.

The shortcomings of the report are the absence of a map and the rather involved arrangement. This, as already noticed, makes it difficult to find certain items of information and renders it necessary to refer to different sections to gather the information on one subject. Even then, in regard to some items, one is left with a feeling of uncertainty as to whether the resultant is trustworthy as there seem to be discrepant statements.

Apart from these defects, however, the report is full of interest and indicates that a 'live' and progressive department has been established in Western Australia. It is all the more to be regretted, therefore, that its author, Mr. Lane-Poole, has since severed his connexion with the State. We do not know who his successor is to be or even whether he has been yet chosen, but all who know Mr. Kessel will hope that, young as he is, the authorities

will let their choice fall upon him as a successor to his former chief and will feel sure that he will not fail to do justice to such a selection.

C. E. C. FISCHER.

[We understand that Mr. S. L. Kessell has since been appointed Acting Conservator.—HON. ED.]

BURMA ADMINISTRATION REPORT.

The Forest Administration Report of Burma for the year 1919-20 has just reached us. This delay of over 18 months in issue to the public beats all the former records held by Burma for many years.

The review of the Report under consideration, written by the Chief Conservator of Forests, well repays perusal and it would have been well had it been made available for general circulation separate from the body of the report. It is now too late to do so but pending the publication of a popular illustrated summary of the annual report as therein foreshadowed the publication of the review and the resolution of the Local Government (when available) might serve a useful purpose.

Turning to the body of the Report, almost every page brings out the evil result of the past (and probably present) habit of looking on a huge forest property such as Burma possesses as an unchanging source of steady revenue requiring only the minimum expenditure either in staff or material to keep it in full yield.

The steady depletion of the unclassed forests over which Government in practice only exercises a nominal control has reached a point where it has become necessary to consider their protection from the further inroads of an increasing population The rate of reservation of new areas has only kept up to the average in the year under report, and although a more rapid rate is forecasted in the Review it is not apparent how this is to be achieved when every other form of forest activity is hampered for want of men.

In this connection the remarks of various Divisional Forest Officers upon thefts of timber are of importance, for they bring

out clearly that the mere reservation of more areas without the means of making their produce or the material from the existing reserves available to the population will do nothing to help the situation. The "dog in the manger" method of reserving areas without bringing out anything or allowing the people to take anything themselves, is doomed to failure under the coming change in the Administration.

Under the head of silviculture it is gratifying to note that at last some cultural work has been undertaken on *Dipterocarpus tuberculatus*. That useful and obliging species is at last receiving proper attention, which makes one hope that teak may be gradually receding to its true silvicultural place in Burma.

The notes in Chapter II, Section 4, on taungya regeneration are especially interesting and it is to be hoped that last year's report will soon be available to bring the results up to date.

The report under the head of Utilisation indicates a revival in the price of teak and the summary of the work done for the Munitions Board reflects well on all concerned. A loss of only 1/3rd per cent. through bad material or handling must be nearly a record minimum for any of the operations conducted anywhere for the Board.

The number of experiments which are reported on from many divisions points to the need of establishing some central agency to follow them up since it is well known that in the past many experiments have been lost sight of on a change of Divisional Forest Officers. A Silviculturist has been appointed who will look after experiments in his own subject but the remainder are still without a guardian.

Forest villages as an industrial development of forestry are evidently going through the troubles of infancy. More than any other development they probably suffer from the shortage of gazetted staff. Without close personal touch with the gazetted officers they are certain to dwindle and cease to fulfil their object.

As usual the report on Roads and Buildings makes sorry reading. It is to be hoped that the revenue authorities have a higher appreciation of the value of the property they administer

than appears from the percentage (about 2·5) of the revenue which they allot to its development. Even a placer miner would spend more on his claim.

Considering the report as a whole one is tempted to wonder whether forestry in Burma is not reaching the same situation as the Railways in India. Real improvement seems to be impossible so long as the money for development depends on the amount the Department manages to secure out of the Provincial Funds at the annual budget scramble. It should surely not be beyond the brains of the Revenue authorities to devise a means whereby the forests of Burma should get their proper requirements in money secured to them several years in advance so that a Department which provides for the revenue of many years ahead should be able to lay its plans free from the uncertainty as to when and whence the money will come.

FORESTRY IN KENYA.

[The following is extracted from the *East African Standard* as Professor Troup's opinions on the prospects of forestry in a new country cannot fail to be of interest to Indian foresters. The address was given at Nairobi in December 1921.—HON. ED.]

Professor Troup said he had not come to give a detailed discourse on the subject because he would have to submit a report in due course which would finally come into their hands so that they would then know his views in detail. He thought, however, it would be a good thing to give them one or more of the more important impressions produced as a result of his visits to the forests of this Colony, and if they were productive of a certain amount of discussion and ventilation of views the object of the meeting would have been fulfilled.

Of course, continued the Professor, any views he expressed must be taken as entirely his own views and not in any way as committing the Government.

Production of Forests.

First of all as regards the production of the forests in this country, as they were probably aware there had been an enormous amount of destruction of forests in Kenya during the past and yet he thought that this Colony could show a better record in that respect than most other

parts of the Empire. There were certain parts of the Empire where forests had been and still were being ruthlessly destroyed and the natural resources of those countries were being wiped off the face of the earth. Fortunately Kenya had taken matters in hand sufficiently early but in spite of that, perhaps through the rapid development of the Colony, the Forest Department, which was understaffed, had failed to keep pace with the destruction of the forests and it was only within comparatively recent times that a more or less hard and fast line had been drawn over which the destroyers of forests had been forbidden to step—that marked a great step in the progress of forest protection.

A Great Loss.

Not many days ago on the Aberdares he went over one important cedar tract and standing on the hillside and looking over a certain valley of only a few square miles he estimated the value of the timber destroyed by fire alone at something like £2,000,000. That was an enormous figure and a very regrettable incident but still there it was. Fire the Professor considered, was one of the greatest enemies possible apart from the actual felling of the forests and one to which cedar forests were specially subject.

He did not refer here to the legitimate clearing of more or less valueless forest land in the interests of agriculture, that was a different matter, there must always be a certain amount of give and take in that way and a certain amount of forest that was not of very great value had to give way to the march of civilisation but it was quite a different matter when they had native tribes coming in and cutting down valuable forests, cultivating it for two or three years and leaving it and allowing that country to become a waste of bracken. That had happened to an alarming extent on the slopes of the Aberdares and Mount Kenya.

He had had it on reliable authority that this clearing of forests on the Aberdare slopes had resulted in the curtailment of the water-supply in certain streams and that was what one might expect in any part of the world, it had always been his experience.

Legislation not Strict.

With regard to the preservation of forests he was inclined to think that the legislation was not strict enough to prevent deforestation of areas that had already been defined as forests and permanently set aside as such. In the speaker's opinion it was too easy to relinquish those

areas. However, that was a matter he would deal with at greater length in his report.

A Comparison.

At present the area of forests in this Colony was estimated to be only 2 per cent. of the total area of the Colony and the merchantable forest at only 1½ per cent. That as compared with the forest countries of the continent of Europe was very small indeed. It was true that the proportion was against a large tract of arid and more or less uninhabited land in the Colony, so perhaps those figures should not be taken as truly representative. The merchantable forest was estimated to occupy only 7·6 per cent. of what might be termed productive land in the Colony, that is to say, the total of agricultural and forest land. That also was a very small precentage.

Reasons for Preservation.

As regards the reasons why forests should be reserved, or conserved and protected those who had any idea of forest economics knew perfectly well that there were several reasons. Forests might be preserved or conserved for the sake of the production of timber and other various products, for the maintenance of the water-supply and prevention of denudation and so on, but when they got to bedrock one argument stood out alone, apart from all the others, the only argument that appeals to a Government and that was "hard cash." They might have forest enthusiasts in various branches of the Government, from the Governor downwards, who might temporarily stem the tide of destruction and inaugurate a strong forest policy, but the only argument which appealed successfully to Governors or Governments was that of hard cash.

In other words the Forest Department must be a paying concern. He did not think it had been sufficiently fully realised in the past that a Forest Department must be run on business lines and must show its profit or loss just as if it was a commercial concern and unless that was done soon the forests would be thrown to the wolves. Only the other day he noticed in the papers a report of a meeting of the Legislative Council when a question was asked why the forests of the Colony did not pay. Well they had paid on occasion but taking it all in all so far, the Forest Department had not been a paying concern. Considering the value of the forests there was no reason why it should not pay and pay fairly handsomely. As far as Kenya was concerned there was a sound reason for safeguarding the supply of timber from the forest and

that was in the matter of future supplies. In regard to pencil cedar, for instance, this Colony might very possibly be not only the leading source of supply but almost the only source of supply. He had been told that the supply of American pencil cedar was dwindling. In India they had searched for years and years for certain pencil wood and tried almost every wood likely to be useful and had not yet found a suitable wood and further they were not likely to.

They had a cedar (Juniper) in Baluchistan which would make pencils but it was a small tree and very twisted and gnarled and of nothing like the quality of the East African cedar, in fact one of the things which had struck him most favourably in this country was the size and quality of the cedar. He did not refer to its soundness and it was a regrettable fact that so much of the cedar was attacked by a fungus which rendered conversion very difficult and risky, but such as it was the tree in itself was probably by far the best juniper tree in the world, certainly larger than the American pencil cedar tree.

Hard Woods.

With regard to hard woods, Professor Troup considered the tree which has been designated camphor to be the primary wood. It was very fine timber, not only handsome in grain and beautiful for constructional and furniture work, but it was extremely durable as well. The only pity was that it grew in places difficult of access and the supply was somewhat limited.

Mr. Hutchins Criticised.

The question of exotics had been rather fully discussed in the papers from time to time and as they probably knew the late Sir D. Hutchins who reported on the forests of East Africa was an enthusiast for exotic trees. The speaker believed that if that gentleman had had his way he would have cleared the whole of East Africa and planted it up as blue gum and wattle. This was something more than a fetish, it was a fad of his and much as he respected Sir David Hutchins' opinion in many particulars he thought he did go too far in recommending the introduction of exotic trees.

The country had some of the finest indigenous timbers in the world; why not use them and increase their supply and leave exotics to their proper function. Exotics had a very good function in the country although he would not like to say offhand that they were going to fulfil all that they hoped of them in the matter of producing large supplies

of fuel. In a short time in a limited area there was nothing like the Australian gums but whether they would have the producing capacity of some of the indigenous timbers remained to be seen ; but one fact certainly stood out ; that with land so limited as it was in this country after they had allotted all farms and other lands, they must get the highest production from that area.

If the material required was fuel and if the gum fuel turned out to be as satisfactory as it was hoped it would be, then obviously the course to pursue would be to plant up with gum which would produce many times the yield of the indigenous trees in a given time.

To that extent they were justified in pushing on exotic trees but to attempt to supplant cedar, camphor and some other of their magnificent local timbers by exotics would be absolute heresy.

He had noticed in the papers criticism of the Forest Department in that they were doing nothing but planting gums. Well, if one stuck to the railway carriage and did not go off the railway one might be induced to form that opinion and he thought people who had formed that opinion had not stepped out of the railway carriage but if they had taken the trouble to take a few steps away from the railway line, at all events into those most recently formed plantations, they would have found that these gums were nothing more than nurses for indigenous timbers. Areas of gum trees would be found sheltering cedar and also other local timbers which require protection in their early stages. These gums would be cut out later and they would be left with indigenous plantations.

Forests Worked Blindly.

Undoubtedly the most pressing thing needed in the Forest Department of this country at the present time was forest surveys and working plans. He was horrified at the lack of good forest maps--good forest maps should be on a scale of 2 in. to 1 mile. With the aid of a map of that kind—a good topographical map—the working plan could be proceeded with.

It came as rather a painful surprise to the Professor that a good many of the forests were being worked "blind" so to speak. The marking officer went out generally accompanied by either the saw-miller himself or by one of his agents. Moral pressure was brought to bear on the marking officer and the cream of the timber had been taken, leaving the rubbish.

This was rather a terrible accusation to make against the Forestry Department but as a matter of fact the Forest Department had suffered not only from want of staff but also from want of any estimate of what the forests contained. If that procedure was continued for any length of time all the saw-mills in the country would have to close down because there would be no more timber to come: also the Colony would be deprived of future timber supplies, the only remedy was to carry out systematic working plans and by working plans he meant those which fixed for a certain period ahead the amount to be cut either by area or by volume and the area to be regenerated.

If his hearers as a body interested in the future timber supply of the country, could do anything to persuade the Government of the vital necessity of carrying out surveys and systematic working plans even if they did nothing else they would deserve well of the Colony.

As regards the method of marking, at present the Forest Department was still in a state of infancy in its method of exploiting the forests.

The system was to go round and mark trees which were considered fit for felling. These trees were scattered about over wide stretches of forests and the consequence was that working was rendered far more expensive than it need be. If, instead of being scattered over a wide area, these trees were selected over 1/10th or 1/20th of the area it was obvious that the timber merchant would work more cheaply and more economically and the system to which they must work, the only rational system, was to let the forests be put into the condition of being worked by clear fellings.

Unfortunately that could not be done at once. Supposing their forests were 100 square miles in extent and they clear felled one square mile every year and planted it up—that was the ideal plan but it would mean that in a 100 years hence there would be mature and overmature trees standing all over the ground and possibly rotting. Those mature and overmature trees must be utilised at last so that they would have two classes of felling, clear felling in one place and felling by selection in another, and that must go on for the whole of a rotation, a rotation being possibly a 100 years or more.

One point on which the speaker said he would like the opinions of those interested in the working of timber was to what extent these clear fellings over part of the area would meet their wishes. He thought there could be only one answer—it would cheapen their work very considerably and would probably be welcomed but not having all clear fellings he

wanted those interested to be quite clear as to what was meant by it As he had previously said he did not mean that would be the only form of felling.

Clear felling would be necessary in the interests of regeneration but at the same time selection felling would have to be continued in conjunction with the clear felling. Another point was that clear fellings could not be made over a larger area than could he planted up at once. If an area was clear felled it must be planted up immediately otherwise it reverted to bush which would be almost impossible to deal with.

Re-stocking.

The question of re-stocking these clear felled areas was very largely a matter of staff and funds. Labour figured as an important thing but staff and funds would go a long way and if they could support any expenditure on regeneration in this way it would strengthen the hands of the Forestry Department and facilitate working and would be to the advantage of the timber merchant himself.

Professor Troup then said that he considered the planting work done by the Forestry Department here was quite the best he had seen anywhere. They were carrying it out on lines which were first introduced in Burma about the sixties of last century. The method of plantation work after temporary planting with agricultural plants such as maize, etc., was all for cheapness and efficiency and this Colony had evolved a system to which in some parts of India they were only just attaining after about 50 or 60 years of groping about. He thought that was one of the greatest feathers in the cap of any Forest Department he knew of.

What was more, they were doing their planting here at an average cost of considerably less than £1 per acre whilst at Home they were now paying anything from £10 to £15 per acre for the same work.

Timber Measurement.

The Professor then dealt with the measurement of timber. The present system was to measure timber standing before being felled. That to his mind was only justified if the measurement was to be regarded as an estimate. If the purchaser of the timber bought a whole "coupe" he buys a whole piece of forest en bloc and the measurement was nothing more than an estimate: he paid a lump sum for a certain acreage of forest, felled timber and utilised it. But to imagine that one was going

to get an accurate measurement of timber by the measurement of standing trees before felling was perfectly futile.

The only satisfactory way to measure timber was to measure it after it had been felled and that had always been done in any place of which he had had experience. To try to fix the value to the nearest cubic foot of a standing tree and to ask the purchaser to pay for it, he thought was asking a little too much ; as a matter of fact the timber merchant generally scored over this arrangement and Government lost but that did not justify the system at all. He thought it would be better in future for both parties if timber was always measured, after felling, and the price fixed per cubic foot and not by the area of a whole stand.

Professer Troup said he would next like to criticise the work he had seen in connection with lumbering and conversion at saw-mills.

Saw-mills and Their Ways.

First of all he was struck in very many instances with the very wasteful system of logging. It was true that the logging industry had not yet become so thoroughly organised that one could insist on intervention all at once but he had seen some flagrant cases.

Take the following instance—

A saw-mill got an order for a quantity of planks 16 ft. o in. long. That order in itself was badly expressed: one did not like to see an order for so many planks 16 ft. o in. long which involved so much waste.

The order should be for planks of 12 x 18 feet averaging 16 or 14 feet or whatever it was ; but that was a detail.

The miller who received the order went into the Forest, felled a lot of trees, cut them into 16 feet logs in the forest and everything that did not come within that length was left lying to waste. A strictly worded agreement would have prevented that or at any rate, Government would have had some remedy. They could not afford, with their limited supply of timber, to leave sound useful timber lying in the forests just because it did not happen to fit in with a certain specification.

Dealing with the mills Professor Troup said they were very good indeed. They knew how to handle timber, but not how to stack it and how to season it. He was not referring to artificial seasoning but was talking of natural seasoning which was a simple process.

How to Season Wood.

It was only a matter of stacking in such a way that the sawn pieces were kept perfectly straight and flat, that free circulation of air was allowed between the pieces, and the sun and rain was kept off the timber. That was all and yet boards which had taken a great deal of trouble and expense to bring out of the forest were thrown down into any heaps in the open in any sort of order exposed to sun and rain.

Of course by the time that the timber came on to the market it had lost about 3/4 of its value and brought also a bad name for the timbers of this country.

Importation a Luxury.

He saw no reason at all why imported timber should be used except in certain very special cases where they had such excellent timber, both hard and soft woods in this country, the remedy was in the hands of those who deal in timber in this country. It was quite useless to throw timber down in heaps after it had been converted or to put it on the market in an unseasoned condition and he thought when they came to export, as they would do sooner or later, possibly sooner than one thought, the need for caution in that direction would be found to be much greater. It would certainly kill any trade in East African timbers for consignments to go out in an unseasoned condition.

He was the last to suggest a form of Government supervision over exported timber but unless timber merchants would take the matter up for themselves and take steps to ensure that only good quality timber was exported there would be no alternative but to insist on Government inspection because they could not afford to get a bad name to begin with.

Australia had had to take that expedient and had Government inspection of exported timber. That would of course mean interference with trade and a good deal of petty worry and annoyance besides expense to the tax-payer and it would be well for exporters of timber to take great care that the necessity for a Government inspector should not arise.

Research Work.

One other point was the question of research work. In the present state of the finances of the country he did not propose to launch forth into any big scheme of forest research. Money spent on research was always in the end profitable, but it did mean considerable capital expenditure

and a good deal of recurrent expenditure, and at present he did not think that the time was ripe to make any very expensive proposal but he should like to see the Forestry Department paying its way regularly as it would do later. He did think one research officer was necessary at once and his principal duties would be to investigate the properties and uses of the more important timbers. Tests for durability could be carried out quite well in this country but tests for strength had better be done at Home for the present, because it meant an expensive apparatus and special staff.

Rate of Growth.

Another question to be gone into pretty thoroughly was the question of the rate of growth and outturn of indigenous trees. That was a thing they knew nothing about and until they knew something about it they would be quite at sea in prescribing anything in the way of possibilities in the future.

Then a thorough examination of the exotic plantation was required. They knew nothing of their rate of growth or outturn and did not know whether they fulfilled the expectations in value as fuel.

They wanted to over haul the exotic plantations and really come to a definite understanding as to whether they should be proceeded with or not and if so on what scale.

Timber merchants and sawyers of timber could help very greatly if they made reliable notes on any points connected with the properties and uses of timbers.

During his visits to various saw-mills he had acquired a number of very useful hints as to the uses of various timbers but all that wanted to be done systematically. Notes of that kind from observation were invaluable in supplementing very strictly scientific tests.

He appealed finally for the assistance of all in furthering the interests of the Forestry Department. He knew from experience that Forestry Departments were apt rather to be looked upon as the enemy of the people, but the Indian Forestry Department had weathered the storm after a good many vicissitudes and was now showing a surplus of something like £1,000,000 per annum and that was a strong argument in its favour.

In helping the Forest staff they would be helping themselves because the business of that Department was to maintain and improve the forests and to increase the output of timber.

Nothing was so fatal as getting hold of a vast area locking it up and doing nothing at all.

As the staff increased, as the working plans were prepared so the area available for work would increase. But as long as working plans were not in existence it would be sheer folly to open new forest areas for working. Provision of working plans demanded staff and money spent on staff for that purpose was money spent on production and was bound to have its return as soon as the working plans were completed and systematic work proceeded with.

The history of the Indian Forestry Department shows that invariably when an increase of staff had been wisely sanctioned an increase in revenue and surplus had followed as a matter of course. That was a forcible answer to certain arguments put forward in the Press to the fact that highly paid staffs were not wanted.

The Department here was not the money making concern it ought to be. The point of view was similar to that of a commercial firm. An under-staffed business was bound to carry on unsatisfactorily whereas a wise increase of staff was bound to lead to development and financial success.

In conclusion Professor Troup said he would be glad to clear up any points that were obscure.

A lengthy discussion followed.

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ARTIFICIAL REPRODUCTION.

BY "TROWSCOED."

In a previous essay the conditions of soil, light and moisture requisite for natural regeneration have been fully dealt with. Exactly the same conditions govern the success of all artificial sowing and planting and in addition several further factors have to be considered.

Artificial reproduction naturally falls into three divisions, firstly the filling up of gaps in areas being regenerated naturally, secondly the restocking of a clear felled area and thirdly the creation of a forest by afforestation.

The question of artificial versus natural regeneration has been the cause of acute controversy for the last 50 years or more. Men of eminence in the profession have taken the most extreme views and schools of forestry have arisen diametrically opposed to one another. The most orthodox French opinion has advocated the advantages of natural regeneration even at the cost of many years' delay, on the other hand the Saxon school declined to have

anything to do with natural regeneration preferring to clear fell and plant.

The mind of the forester will always be influenced to some extent by the school of thought in which he was brought up and, however broad-minded he may be, he will probably have a preference for that style of silviculture with which he is best acquainted and of which he has become a master.

In recent years this controversy has continued with respect to the effect of planting in reducing the vitality of an artificially raised crop when handled under a long rotation. Toumey states in his work "Seeding and Planting," "It is generally acknowledged that the artificial stand as compared with the natural is more quickly established and more uniform in distribution and in the size of the individual tree. The growth during early life is also more rapid. It appears however that it is more sensitive to external harmful influences and that the trees begin to fail or fall off in increment at an earlier age than in stands that have arisen from natural seeding."

"Where natural regeneration is possible the trend of present day forestry in Europe is away from pure stands and artificial regeneration towards mixed stands and natural seeding. In Saxony where spruce has been planted in pure stands for successive generations a change is now being made towards natural regeneration and mixed stands. It is believed by many that the repetition of the same species rotation after rotation ultimately exhausts the soil."

Believing as we do as a general rule in the superiority of natural over artificial means and, considering that the best practice is likely to be that which approaches most nearly to the regime of nature we welcome this trend of modern thought and consider that there can be no question but that the art of silviculture finds its highest expression in the successful natural regeneration of a mixed crop. Nevertheless under certain circumstances clear felling and planting is the only satisfactory system of management giving the most valuable crops and the best financial results. This is probably undoubtedly so in the teak forests of Burma

where this method combined with the cultivation of field crops has given good results out of all proportion to those obtained by natural means. A similar method of treatment has been adopted for the Bengal sal forests which is described in detail in the Indian Forest Record by Messrs. Glasson, Russell, Shebbeare and Teague. It is still open to doubt however whether it will be possible to obtain the labour necessary to regenerate the normal area by these means and it is probable that the regeneration of the Goalpara sal *forests can only be obtained by natural seeding.* It must always be a confession of failure when natural regeneration cannot be obtained where it is required, more especially in the case of gregarious species like sal and the conifers.

Under the conditions which prevail in Britain clear felling and planting is almost the only system worth considering and the planting of teak in Nilambore is probably the finest piece of work done by the Forest Department in India. Bourne goes so far as actually to root up natural teak seedlings which come up between his transplants and his thinnings are reduced to almost a mechanical operation.

Even Blanford's system for the natural regeneration of teak in Burma has been superseded by artificial regeneration which is considered to give superior results.

The two extremes of silvicultural practice in India are well illustrated by comparing Collier's system for the natural regeneration of sal, in which regeneration commences in the second period or forty years before the end of the rotation with Bourne's practice with teak in Nilambore in which complete regeneration is obtained in one season. In our own practice after a long and intimate acquaintance with both natural and artificial methods in the regeneration of the Himalayan conifers the following conclusions have been forced upon us so far as these species are concerned *:—*

(1) That natural regeneration is always superior to artificial work.

(2) That artificial sowing and planting is essential to the complete and rapid stocking of the area under regeneration.

(3) That reproduction whether natural or artificial should be obtained within the shortest possible time after the first regeneration felling.

Following on these results a technique was developed embodying the best points of both schools of thought and aiming at natural reproduction wherever possible supplemented immediately by artificial work, undertaken largely for the purpose of augmenting the proportion of deodar in a mixed crop of deodar and blue pine. The Kulu working plan considering the requirements of silviculture to be paramount is founded on this practice. Other authorities, however, are of the opinion that the requirements of exploitation are of prior importance and advocate a system of clear felling and artificial regeneration on the Saxon lines. Before a system of forest management can be founded on these principles it will be necessary to show that artificial reproduction on the suggested scale is a practical proposition ; so far as our experience goes, the artificial regeneration of clear felled areas in the hills especially on warm aspects has been a work of the greatest difficulty. There is little doubt that such a system will succeed on favourable aspects after burning the slash, but whether the system is suitable for general adoption is another matter.

As an example of the third division of our subject the afforestation of the ravine lands of Etawah may be mentioned. In this case the whole forest was destroyed several centuries ago, since when the conditions of climate and water-supply have entirely altered. The conservation of the limited rainfall becomes the first essential to success. To this end the work is governed by the well known rules of dry farming ; the soil is deeply ploughed and ridged to prevent run-off, and the ridges are constantly weeded and the soil loosened to diminish evaporation. In the area treated denudation ceases, the jagged outlines of the ravines become rounded off and a mixed crop of Babul and Sissu covers the ground under which a plentiful supply of good fodder grass springs up. A desolate waste is in this way turned into a fuel and fodder reserve of inestimable value to the surrounding agricultural population.

The Landes in France is an instance in which afforestation has turned a fever stricken waste into one of the richest provinces of France. The reclamation and forestation of these sand wastes in perhaps the best possible illustration of the benefits of forestry to the individual, to the community and to the nation. Instead of dreary wastes of sand and swamp 1,611,421 acres of Maritime pine forests give a net annual revenue of £675,500 and provide a livelihood for the local population.*

The Eucalyptus plantations of the Nilgiris and the irrigated Sissu plantations of the Punjab show how the face of nature can be transformed by the art of the forester and a barren country turned into a productive garden.

It is now necessary to consider the technique of artificial regeneration in all its aspects, to discuss methods of sowing and planting and the various factors which make for success in these operations.

If artificial reproduction is to be undertaken at all it is absolutely necessary that every detail of the proper technique should be given minute attention, that constant personal supervision should be exercised and that the work be organised on a businesslike footing. Large sums have been wasted by inattention to these matters. Success in this work is almost entirely a personal matter. With exactly similar advantages one man will succeed and another fail. The latter will plead drought, frost, hail, excessive rain or some other vicissitude of nature entirely beyond his control, when as a matter of fact his failure is entirely due to his own incompetence. There is only one way of judging the capacity of the forester and that is by the results he can command. The successful man is one who can grow crops at a profit, no scientific knowledge is of any value if it cannot be applied to this end. "Two centuries of forest culture in Europe have conclusively demonstrated that successful artificial regeneration is chiefly a matter of soil management."

The following are the factors to be considered :—

(1) Selection of suitable species.

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* Studies in French Forestry by T. S. Woolsey, 1920

(2) Soil preparation.
(3) Seed supply.
(4) Nursery work and direct sowing.
(5) Planting.
(6) Tending.

(1) Selection of Suitable Species.

This point is obvious but has only been too frequently neglected in the past. Innumerable instances are known to almost every forester of the planting of species unsuited to the locality. Large sums of money have been wasted on planting deodar on bare hill-sides in the eye of the sun in positions where the work was foredoomed to failure. The planting of larch in Britain under entirely unnatural conditions has resulted in widespread epidemic disease, and not even warned by past experience the planting of exotics to the neglect of indigenous species still continues. As a general rule it is best to employ species natural to the locality to be planted, if these are of sufficient value, and to defer the wholesale introduction of other species until experiments have shown that good results can be obtained. In any case attention must invariably be paid to the soil and climatic requirements of these exotics in their natural environment.

Given suitable silvicultural conditions the most valuable species should always be selected as the costs of formation usually are constant for all species. If teak can be grown successfully it is useless to plant other species unless these are required to form a mixture with the teak. This tree is one of the easiest to manage, it grows very rapidly in early youth and even outside its natural habitat has been found to be a very valuable species for planting work. In Gorakhpur after exhaustive trials with many trees, teak has been found by far the best for filling up blanks in the sal coppice, and a plantation of indifferent quality 40 years old in this division has been sold for over Rs. 1,000 per acre, giving better financial results than the native sal.

A species may show very fine results at the start but later on may be a financial failure. Sissu is the only species for the

first afforestation of the Punjab irrigated plantations but later on it is destroyed by the fungus *Fomes lucidus* and mulberry very fortunately takes its place. It is doubtful whether the Sissu plantations of the Kumaun bhabar will be more than a temporary success and every effort should be made to introduce under the Sissu species of more permanent value.

(2) *Soil Preparation.*

Whether in the nursery, in direct sowings or in planting, the preparation of the soil is directed to the production of a good tilth to provide the factors most favourable to germination and the rapid development of the seedling. On the latter frequently hangs the success or failure of the whole work. Given the best, or at least suitable conditions for germination and growth, the exact nature of the method of soil preparation employed is of minor importance. This will vary with the requirements of different species, the nature of the soil and the costs permissible. It is useless being able to point to success regardless of the cost; success is only attained when the area has been stocked with trees at a cost which will give satisfactory financial results. Wood in his article in the *Indian Forester* for February 1922 has given an instance of the influence of soil preparation on growth. In the old Gorakhpur nursery the soil was dug to a depth of 1' in June and sal sowings made, resulting in an average annual height growth of 1' 1⅛" over a period of 8 years. In the new nursery the soil was dug to a depth of 1½' in December and sal sown in the following June resulting in an average annual height growth of 1' 5" over a period of 4 years. Sal root and shoot cuttings have been a failure under forest conditions, they have only succeeded under nursery conditions with intense soil preparation. Smythies records an instance in the Motipur plantation of Bahraich where a typically xerophytic vegetation of *Ægle Marmelos*, *Dyospyros* and *Odina Wodier* has been turned into sal forest by intensive soil preparation and direct sowings. The success of deodar sowings in heaps of burnt slash has already been commented on and similar results have also

been obtained with teak. The success of the taungya system in Burma and Bengal is entirely due to the efficient cultivation of the soil obtained by the growing of field crops combined with the provision of the full overhead light so necessary in the case of teak. A mulch of dry earth has enabled Chir pine seedlings to survive on a particularly dry area where otherwise they invariably died of drought and this method had been extensively employed in the dry teak forests of Bombay. Many species require very special conditions of soil for their germination; *Alnus nepalensis* in Kulu, *Dalbergia Sissoo* and *Acacia Catechu* in the submontane tract and *Populus euphratica* along the Indus all require fresh river alluvial deposits for their reproduction, and a similar soil with an absence of weeds must be provided in raising these trees under artificial conditions. In the United Provinces it has only lately been discovered that absolutely clean soil is essential for the germination of *Adina cordifolia.* This tree has been raised on mounds in the bhabar but only with considerable difficulty as the minute seed is easily washed away. Profuse natural regeneration has been obtained accidentally in an area under experimental regeneration of sal after making a heavy felling and burning the slash, the resulting ashes giving exactly the conditions required for the germination of this tiny seed.

In the case of the afforestation of the Etawah ravines everything depends on proper soil preparation. On the flat uplands the whole ground is deeply ploughed and ridged 10 ft. apart to prevent run-off and the sowings of Babul and other species are made along the ridges. The cultivation of 3 lines of cotton plants between the ridges has now been commenced both with the view of improving sal conditions, diminishing weed growth and reducing the costs of afforestation by the profits on the cotton. Intensive weedings and soil loosening form part of the standard practice; everything possible being done to conserve moisture and increase the rapidity of early growth in this almost desert country.

A perfunctory soil preparation is most generally attended with failure. Dibbling teak in Burma, patch sowings of sal, broadcast scattering of miscellaneous seeds in the Saharanpur

coppice coupes have generally utterly failed, either from this cause or from subsequent neglect of weedings. In Etawah complete failure involving the loss of a large sum of money was the result of employing an incompetent officer. Innumerable instances could be given of the importance of adequate soil preparation; enough has been said to show that the success or failure of artificial reproduction is very largely dependent on this cause.

(3) *Seed Supply*.

It is manifest that to obtain success in this work good seed must be used. This is insisted on by every authority on the subject. Seed may appear perfectly good and yet not be worth sowing. The first seed that ripens is frequently unfertile and useless. The seed of *Anogeissus latifolia* which is collected before the end of March is worthless; Sissu seed should never be collected off the ground and the same remark applies to the other species and is especially true in the case of small seeds. Thus in 1919, seed of *Anogeissus*, *Holoptelea* and *Dalbergia* collected by sweeping up the seed on the ground gave very poor results. In the Afforestation Division it is a standing order that Sissu seed is always to be collected off the trees and never from the ground. Some of the larger seeds such as teak, *Gmelina*, sal, *Odina* may be collected off the ground after they have fallen. Babul seed which has been eaten by and passed through goats has been found to have a very high germination per cent. Some seeds such as ash only germinate in the second year. Babul does the same in years of deficient rainfall when the seed remains dormant in the soil. Some of the larger seeds such as teak require special treatment to induce early and even germination, without such treatment many seeds fail to germinate the first year. There are many factors which influence the fertility and vigour of seed, the most important of which may be briefly summarised.

(1) In a good seed year the seed is invariably better, the germination per cent. greater and vitality higher than in a bad seed year. This has been proved to be the case many times with the Deodar where in a good seed year the success of artificial

reproduction is much greater than in years of poor seed supply although there is no apparent difference in the seed.

(2) The complete ripeness of the seed is a vital factor, seed should, be collected when ripening is at its maximum, early and very late seed should be avoided.

(3) In many species (*e.g.*, sal and Sain) the size of the seed varies considerably; the fertility of large well developed seed and the vigour of the resulting seedlings is a well established fact.

(4) Recent investigations have shown that variations in the characteristics of the mother tree due to soil and climate may be transmitted through the seed. Thus in Etawah local Babul seed is useless for afforestation work on account of its deep rooted habit, and to obtain the best results the seed has to be obtained from the Hamirpur district where the tree has developed a shallow rooted system owing to water-logged soil conditions.

In the Etawah district plantation areas the spring water level has sunk in the last 300 years from about 60 feet to over 100 feet as the result of erosion, and the rain water now penetrates the surface soil to a depth of a few inches only; below this the soil is absolutely dry and compact until the spring level is reached. There is absolutely no natural regeneration from seed, and it is thought that the isolated trees are the offspring of coppice stools of great age whose roots have kept pace with the sinking spring level. Roots have been dug up at a depth of 102 feet. This deep rooted character of the Etawah Babul seems to have been transmitted to the seed. The intense soil cultivation prior to afforestation increases the surface seepage sufficiently to enable the ordinary shallow rooted form to develop, but it is insufficient for the deep rooted form which fails to pass the dry strata in its endeavour to reach the spring water level.

Zederbauer has shown that seed collected from suppressed or subdominant trees produces plants less resistant to disease than the seed collected from dominant trees, but also that individual characteristics of the mother tree, such as unusual divergence from the typical form of the species, may be transmitted through the seed (Toumey—Seeding and Planting in the practice of

forestry). The researches of Champion on the subject of twisted fibre in *Pinus longifolia* tend to show that this defect in structure is transmitted through the seed. The Almora plantations were certainly made with seed from twisted Chir and many of the trees now show twist. It is of the greatest importance that all afforestation with Chir pine should be carried out with seed obtained from straight fibred trees.

Similarly in the case of Deodar and Kail seed required for afforesting high elevations should not be obtained from mother trees growing at low elevations, as it has been clearly shown from extensive experiments in France and Switzerland that the height growth of Scotch pine and spruce obtained from Alpine seed commences earlier and is completed sooner than that of plants from lowland seed, and that the latter have difficulty in maturing their wood before the advent of the winter. Also that at ordinary elevations the height growth of plants obtained from mother trees growing at such elevations is much greater than that of plants from Alpine seed.

Sowings of Kail at 9,000 feet in Kulu, with seed obtained from trees growing at medium elevations, failed as the seedlings were killed by the winter cold. It is probable that better success would have been obtained if seed from trees at the maximum elevation of 10,000 feet had been used.

The cause of failure of many of the Swedish Scotch pine plantations has been attributed to the use of German seed and much better results have been obtained with larch seed from Scotland than with Alpine seed. For planting on dry areas in the United Provinces teak seed should be obtained from dry localities in Bombay or the Central Provinces in preference to seed from trees growing in a moist climate.*

* Toumey "Seeding and Planting," "The Forest Pocket Book."

(To be continued.)

FORESTRY IN THE BRITISH ISLES.

PART II.

The national forest policy falls under two main heads:—

(*a*) The Ultimate Objective, which is the creation in Great Britain and Ireland of reserves of standing timber sufficient to meet the essential requirements of the nation over a limited period of three years in time of war or national emergency.

(*b*) The Immediate Objective, which is a ten year scheme based on a block grant.

To achieve the former it would be necessary for the State to afforest 1,770,000 acres of land previously unplanted (of which 1 180,000 acres should be planted in 40 years and the whole in 80 years) and at the same time to take steps to secure the continuance under timber and obtain an increased yield from the 3,000,000 acres of private forests which existed in 1914.

The Immediate Objective is an instalment of the complete plan. This comprises afforestation by the State of 150,000 acres of new land, assistance to Local Authorities and private owners for the afforestation of 110,000 acres; purchase and reconstruction of hardwood areas; education of the staff and of land-owners and land agents; research and experiment and encouragement of forest industries.

The financial policy is based on the necessity of knowing for some time ahead the scope of the work in hand. Accordingly a sum of £3,692,000 was set aside by the Forestry Act of 1919 to cover the expenditure of the first ten years. The main objective of the Commissioners is to secure a supply of timber for the country, and all expenditure on staff, education, research, assistance to private owners and corporate bodies, acquisition of land, purchase of materials, etc., form part of the organisation which the administrative authority has to provide for.

The programme of work and expenditure was based on a subdivision of the ten-year period into three sub-periods. The first is devoted to general organisation in all directions of its activities; the second to land acquisition and planting at an effective rate; and the third to completion of the ten-year programme and preparation for a second decennial period. The latter is of extreme importance in consideration of the fact that if progress is to continue it would be necessary in the seventh year to purchase seed and supply 90 million seedlings in addition to the acquisition of 50,000 acres of land to insure continuance of the policy at the same rate of progress in the tenth and eleventh years. The Commission felt that while the block grant system has much in its favour the decision regarding the continuance of the afforestation work into a second ten-year period should be arrived at not later than the sixth year of the first period. The land policy, relations towards private forestry and education are given in considerable detail. We have not seen however the details as to the manner in which grants to private owners or proceeds-sharing schemes are actually worked. It is evident that substantial guarantees must be forthcoming.

The report closes with a short but clear account of the first year's work both in cultural operations and in the direction of education, research and special services.

Statistics of imports of timber, wood manufactures and pulp wood, with graphs, help to complete a most excellent and interesting account of the past history of British Forestry and of the recent measures taken to establish an effective State policy in forest matters. The Forest Commissioners have shown us how to render an account of our work interesting to the layman as well as to the professional man.

* * * *

A perusal of the Report reviewed above would lead one to suppose that all is well and that the British Isles will in due course be prepared for an emergency such as was experienced during the Great War. In "Nature" of February 16th, 1922, in an article on "Research and Education in the Geddes Report" we

see that the Retrenchment Committee proposed to discontinue the scheme of national afforestation; we quote as follows:—

"The activities of the Forestry Commission are threatened with extinction by the Report, which recommends that the scheme of afforestation by the State shall be discontinued, that the vote of £275,000 for the ensuing financial year shall not be allowed and that steps should be taken to cancel the remaining £2,822,000 of the £3,500,000 authorised for the decade following 1919, the date of the Forestry Act. In the Report no complaint is made about the work or the administration of the Forestry Commission. It simply says: " We recognise the enthusiasm and public spirit of the Commissioners, but in the present state of the Country's finance we cannot recommend that this expenditure which will always show a heavy loss, and which cannot reach full fruition for something like eighty years—should be continued."

" Foresters believe that afforestation will show a profit rather than a loss, but this is not the real issue. The Committee ignores the main argument for afforestation in Great Britain—namely, national security. This country, without an adequate supply of timber within its own shores, is exposed to great peril in time of war. During the Great War the expenditure incurred on foreign timber was £200,000,000 more than if the prices of 1913 had prevailed, and the enormous cargo space needed for such a bulky import endangered our food supply from overseas, and at one time brought us to the brink of starvation. The insurance against such a calamity, £350,000 annually, is a trifle. No heed is given in the Report to the cheapness of the afforestation, which is carried out in many cases on leased land, no capital expenditure for land purchase being required. The Government in November last actually allotted to the Forestry Commission an extra £250,000 out of the Unemployment Fund, which puts 5,000 idle men at work in replanting the woodland areas felled during the war. The Forestry Commission has acquired large areas of land; it has entered into many leases and contracts; it owns millions of seedling trees ready for transplating; it has established schools for woodmen and instituted research. It is

evident that the "scrapping" of such an efficient service would result in an immediate great loss of money and be a waste rather than an economy."

Fortunately Parliament has not accepted the Committee's recommendations in this respect and Government has announced its intention to continue the year's grant of £120,000 to the Forestry Commission. Retrenchments on the original scheme are probable and it does not seem likely that much money will be available for higher or specialised education in Forestry.

SOME C. P. REMINISCENCES.

BY A. W. BLUNT, I.F.S.

(*Continued.*)

One cold weather in Raipur I was after some man-eaters in the Dhamtari Range. When we arrived in the neighbourhood we found that every path and every cart track round showed tracks of several tigers of various sizes. The original culprit was a tigress who had begun man-killing about twelve months previously to feed her small cubs, and during the year thirty-two people had been killed. There was a considerable panic in the neighbouring villages which depended mostly on the reserve for grass, fuel, and grazing. We could not say exactly how many tigers there were, owing to the crowds of tracks of varying sizes, nor could we tell if the man-killing was due only to the tigress and her growing family, or whether she might not have imparted her improper tastes to one or more of the male tigers. In Chhattisgarh with its Chamar population, there was seldom any difficulty in buying as many worn out bullocks and cows as we required for kills, so A. K. started off with a bunch of old hair trunks to tie out, and apparently put out nearly a dozen. Next morning no result, though tiger tracks were everywhere. Next morning the same, to our disgust and A. K.'s perturbation.

About 7 o'clock that evening as I was sitting in my tent, A. K. burst in on me in a furious rage. He naturally began his story at the wrong end, but as he became coherent, I gathered

the following. He did not want to buy outright all the cattle required for kills, so he had arranged with several villagers to let him tie out their old animals; they would be paid the price of any killed and for the rest would get bucksheesh for their trouble in tying them out every evening. The villagers however, thought they would do better over the bucksheesh, and while A. K. went round with them and tied up the bullocks, their bhais followed, loosed the animals and drove them home, taking them out again and tying them up in the very early morning before A. K. visited them. The previous day he had suspected something of the sort from various signs, so this time, after finishing his round, he slipped away for a second inspection and found, as he had suspected, that the bullock tied in his most promising spot had been taken away. So he just squatted by the tree and waited. In a short time he heard the men coming and they appeared with the bullock which they said had broken away and gone home to its shed. Apparently A. K. had made some remarks about his suspicions during the day, and when the villagers found that he had disappeared after his usual round, they guessed what he was up to and replaced the missing animal. This has always appeared to me a case of most reckless disregard of a very probable risk He went and sat alone in the dark at a place which he had specially selected as one of the most likely places for a man-eating tiger to pass. He was alone and unarmed except for a little Baiga axe which was his usual walking stick. There was no excitement in the surroundings except his righteous wrath against the villagers, to stimulate him to take the risk. I think there are very few of us who would do the same even if well armed with a powerful battery.

I may add that either on that or the following night one of these kills was taken, and in the ensuing beat I shot the tigress and two of her cubs and missed the third cub as it gallopped over the rocky nala bed within twenty yards of my tree. A bad miss which I have always regretted as being the only chance I have ever had of bagging four tigers to my own gun in one beat. The cubs were about the same size as their mother, taping only two or

three inches less than she in total length, and were probably about two years old.

A. K. suffered from chronic bronchitis and a constant tearing cough, due entirely to the way he incessantly exposed himself to the night and morning dews and air when looking after his kills. It never yielded to any treatment and could only have been cured if he would have consented to give up his shikar, which was impossible. One hot weather in Raipur I met M. of the Forest Surveys. It was one of the bad cholera seasons with which Chhattisgarh used to be afflicted before the East Coast Railway was constructed to Puri, this diverting the stream of pilgrims from up-country. In that season the Deputy Commissioner told me there were 20,000 reported deaths from cholera in Raipur District. I had lost two men in my camp, one a camel driver, and the other my tent Khalassi, and had found several small villages completely deserted on my march. M. was quite a good doctor for simple ailments and had a large medicine chest, so I turned A. K. on to him to get some alleviation of his cough. M. made him up a bottle of medicine and gave it to him with directions. Later in the day as we were sitting at tea, A. K. appeared at the door of the tent with a haggard face and evidently in a blue funk, and said, "Sahib, I have got cholera; I have been violently sick." We were all very much on the jump about cholera and I turned in consternation to M. who, to my relief, burst out laughing, and asked A. K. "What did you do with that medicine? Did you drink the whole bottle?" A. K. confessed he had, and then M. explained that he had made up an expectorant with tartar emetic to be taken in small doses. A. K., of course, couldn't be bothered fiddling with small doses and had drunk the whole bottleful at once to expedite his cure, with the effect described.

Poor old A. K.'s cough got worse and worse and I believe developed into consumption. He wouldn't give up trying for tigers and in 1899 accompanied me on a three month trip to Bastar State where I was deputed to report on the forests. He got worse and worse on the trip and developed dropsy which incapacitated him from any exertion. When I got back to Raipur

I put him on the train, as he wished to get back to his home, and I heard he died within a very few days of his arrival.

I hope that in Paradise he has found an endless succession of tigers to circumvent, otherwise I doubt his being a very contented spirit.

I have been very lucky in my time in not having many wounded tigers to follow up, mainly owing to having them brought up well in the beat, so that they generally offered easy shots. With the help of A. K. I learned how this can be done, and with him I had very few failures to kill the tiger close to my tree. One such I remember very clearly. A big tiger had killed a village cow in very open scrub on the outskirts of some cultivation where every vestige of grass had been burnt off by the mohwa pickers. Nothing was left but some scanty sal scrub on the red laterite soil. A heavy shower had fallen two days before which supplied the only water available in the shape of one or two muddy pools in the narrow ravines or clefts which form the extreme heads of nalas in such soils. A. K. came in and said the tiger was lying by one of these pools. I must confess that when I looked at the place in the middle of a hot day I was very sceptical, as there wasn't an atom of shade, but A. K. was so positive, that we took my machan to the edge of the forest about 150 yards away and tied it up between three or four sal saplings which stood conveniently. A. K. then took about twenty men to the far side and raised a yell, on which a very big tiger emerged with a pop, apparently from the unbroken maidan, and galloped roaring straight at me. I waited till he was about five yards in front of me and tried to hit him between the shoulder blades. I suppose the pace and the noise disturbed my aim, for he passed on without a pause, and looking down on him over my shoulder I saw my bullet mark showing with a white rim, before the wound began to bleed, just *outside* the tip of his left shoulder blade. I was cramped in the machan and couldn't swing round quickly, and before I could fire again he had passed over a slight rise and disappeared. We found a little blood for two or three hundred yards after which it stopped and the tiger

apparently went on and on, for we never found a trace of him, nor did we ever get news of him again. One would think that a 500 Express bullet with a heavy base such as I generally used, at a distance of seven or eight yards, would have caused sufficient shock even in a big tiger to pull him up for a few seconds. I can only suppose that the pace at which he was travelling carried him over the first shock, after which he was able to carry on without much inconvenience beyond local pain. This episode certainly increased my ideas of the enormous cushioning and resisting power of the muscles in the shoulder of a big tiger. I always avoided firing at the shoulder of a tiger whenever possible, and with a broadside shot always aimed just behind it and rather low down. This shot gets the lungs and very often a splinter of bullet cuts the heart as well. A tiger will fall to this shot very often on the spot and will never go more than about 100 yards. I believe the distance traversed after such a shot depends on the condition of the animal's heart at the moment of being struck *i.e.*, whether it is in a state of dilation or contraction. Certainly the distance travelled on different occasions varies very remarkably. Once in Rewah, two young, but full grown tigers, came out to me and they both fell to this shot, practically in their tracks. Later in the beat a very small panther came along and I hit it in the same place. It travelled quite 150 yards before falling, and when we picked it up, the chest cavity was perfectly empty, and looking into the bullet hole we could see the ribs on the further side.

An animal hit with this shot will always rush straight ahead and apparently can never deviate from its course, while any check to its career such as a bush, or a tangle of creepers, means the end of its course.

For practically all my shooting I used the old 500 Express rifle, at first with black powder and later with low pressure cordite or axite. As a rule I did not use the copper tubed "trade" bullet of 340 grains, but cast my own bullets with a hollow of about one half the "trade" depth, thus making the bullet slightly heavier and the base considerably stronger. I found the penetration

of this bullet excellent. I have known the base to drive right through a tigress, behind the shoulder, while it did not break up into small splinters immediately on impact, as the "trade" bullet is liable to do on a tiger's muscles. At the same time, the apex mushroomed quite sufficiently to cause a very severe "stopping" wound when properly placed. I have never used a H. V. rifle. If I had I should probably have altered my ideas of vital spots considerably.

I have seen it stated somewhere that the tiger never seizes its kill in its mouth or lifts it with a leap over an obstacle as the lion can do with ease, and also, that the tiger practically cannot leap to any height clear of the ground. This is certainly true as a general statement, but I have known one instance where a tigress must have jumped with her kill in her mouth. My old pal H. was out with me in the Lormi Range of Bilaspur. We had heard of a tigress which had killed a number of cattle and whose destruction was desired by the villagers We accordingly put out several kills on her accustomed tracks, but in the morning nothing had been taken, so we went round to try and find the reason for the failure. We soon picked up her fresh tracks in a neighbouring nala and followed them up the bed. In a short time we came on a pool in a bend at the foot of a high bank. The water in the pool was full of blood and the tracks showed that the tigress had killed a chital, but there was no further sign of a drag in the sand. We afterwards found the chital (a young stag) in the jungle above the bank. The bank was twelve to fourteen feet, practically perpendicular, and half way up was a narrow ledge not more than two feet wide and sloping outwards. The tigress had evidently surmounted the bank in two springs, and she must have carried the chital in her mouth while so doing, for there was no sign of her dragging the kill up the cliff. It is impossible to guess why she performed this unusual evolution, for she could easily have dragged the carcase across the nala where the bank was shelving, or have avoided the steep cliff by dragging it a very short distance either up or down stream to where the banks were lower.

As for leaping clear of the ground, I have heard of a tiger pulling a stop out of a tree when the tiger's claw marks on the tree were measured to be sixteen feet from the ground. I was not present, but was told that it was a perfectly straight tree with no advantage of slope in the ground to help the tiger. This could hardly have been done even by the reputed thirteen feet tigers without a spring from the ground.

Talking of the length of tigers I have never shot a ten foot tiger, or anything near it. I have heard of one or two in the C. P. of this length by fair measure between pegs; as far as I remember one was ten feet two inches, but the C. P. tiger does not generally run to great length. The longest which I have shot or seen shot was nine feet eight and a half inches, a rather lanky old tiger who had been hunted before. He came out at a gallop, immediately the beat started, and when we skinned him we found an old Martini bullet embedded in the muscles of his neck. The C. P. tiger does not generally grow longer than nine feet six inches but he is very thick and massive with enormously powerful forequarters. The tigress is usually about eight feet three inches, or eight feet four inches. As far as I can remember without notes, a heavy tiger weighs about 480 lbs. The heaviest I ever heard of was 530 lbs. shot by H. in Bastar. He told me it was an enormous beast and just pulled down his 500 lb. Salter balance and his 30 lb. fish scale when put in tandem. The smallest full grown tigress I weighed was 240 lbs.

I have seen the skin of a white tiger which was shot in the Lormi Range, much to my sorrow, by an outside shikari sahib. I had heard of the beast and had tied out kills for it on my first tour in the Range that season, but with no fortune. The gentleman in question came along a little later, got a kill taken the first night he arrived in Achanakmar, sat up and shot the tiger the next evening. He told me that it was very dark before the tiger came out and that he would not have been able to see a normally coloured beast. The skin was that of a very large tiger, the ground colour being white, just tinged with cream, and the stripes, which were as numerous as in a normal skin, of a very

deep chocolate brown. A magnificent trophy, which I was very disappointed I had not been able to secure myself. The sportsman had no further luck as he contracted a very bad go of fever in those unhealthy jungles and had to return whence he came. I heard subsequently that this tiger had evidently left his mark, for two other white tigers were reported near Bindawal, but I never got a chance at them.

As I have said above, I have had very good luck in not having to walk up to many wounded tigers, but I have had to on a few occasions. I had frequently heard of the value of buffaloes on such occasions, and whenever I could, I sent for a herd of these to help me. The accounts which I had heard always referred to the regular graziers' buffaloes which were kept all the year round in grazing camps ("daihans" in Chhattisgarh) in the forests and accustomed to daily meetings with tigers. One herd was described to me as pursuing the line of a wounded tiger like a pack of hounds running by scent, led by an old cow with her tail in the air, until they came up to the tiger who was forthwith pounded and gored to a pulp. I never required the services of buffaloes when I was within hail of one of these "daihans" and my only experiences have been with village buffs, male and female, and though I have got the tiger ultimately, it was not by any spectacular methods, as I had been led to anticipate. In fact they appeared to me abnormally stupid and their main value was to distract the tiger's attention.

On one occasion in the extreme east of the then Dhamtari Range, on the banks of the Pairi, now I believe included in the Singpur Range, a friend B. wounded a tigress in a beat late in the evening, and we could make out nothing before dark. I called on the village buffs to accompany us and we started off early next morning. We cast our pack through all the likely ravines and thickets without a sign, until we at last arrived on the bank of the Pairi, here about quarter of a mile wide a great stretch of sand just warming up on a day late in April. The men said there was a pool of water at the other side of the river, so we sent one of them across to see if there

were any tracks, and we sat down and waited. A. K. in the meantime, restless as ever, strolled about in the sal scrub behind us. Suddenly he rushed up with "Sahib, here is the tiger behind a bush." Up we got and went with him, and, sure enough, within forty yards of where we had sat down was the tigress lying crouched behind a bunch of sal coppice almost broadside on to me. Hoping to finish it off cleanly, I fired at the neck and missed. Up she got with a roar and bolted, tail in air, straight away. I took careful aim in the middle of the target and fired my left barrel, on which she turned round and came down roaring loudly, straight at us. Fortunately she had no intention of charging, but squatted behind a fallen tree trunk among some sal coppice. We now knew to an inch where she was, but couldn't possibly get a view of her, so I took up my stand to command one bolt way and put B. in a fork of a tree, whence he could look over the scrub and see her if she only moved slightly, and then called up the buffs with orders to the men to drive them very gently over the tiger. They obeyed perfectly, and the buffs wandered in their usual casual manner till they were nearly on top of her. One buff was exactly on the line until it came to the log behind which the tigress was lying. It poked its nose over and then stood in meditation for quite a minute, while we waited breathlessly for results. It finally concluded that, though there was an unusual smell under its nose, there was nothing to worry about, so it lifted one foot and planted it over the log right in the middle of the tigress. Then things moved. The tigress jumped up with an expostulating roar and squatted again in another bunch of coppice about five yards away, while the whole herd of buffs scattered like a rocket bursting. B. could now see her and finished her off. We found that she was quite a young though full grown tigress and that B. had hit her the evening before through a fore paw. I have heard that a bullet wound in the hand is one of the most painful and demoralising wounds that can be experienced. This is possibly the same with animals, reading paw for hand, and this wound, coupled with her youth, so demoralised her that she had no idea whatever of showing fight.

On another occasion I was after a man-eater, near Baihar in Balaghat. She was a tigress with half grown cubs and had evaded a meeting with one or two other sportsmen. At last she took one of my kills and I sat up for her. She came just before dark and I fired at her chest. I found afterwards I had hit too high, getting her in the throat and inflicting a knock-out blow, but not one that was immediately mortal, though she would probably have died of starvation as a result. Next morning I sent for the village buffs and took them to the spot. We found fresh blood from the place where she had lain during the night, as hearing us coming, she had moved across a small nala to the other side where there was a heavy growth of speargrass some three feet high. We put the buffs into this and waited. I continued waiting for over an hour while the buffs grazed casually about and gave no sign of being aware that a tiger had passed that way within the last month. I wouldn't advance and wouldn't let the men advance, as the tigress was evidently very reluctant to move and one of us might stumble on her anywhere in this high grass. At last, at the suggestion of one of my men, I sent for the herd of village cows and put them in. They had not gone twenty yards when up went their tails and they skedaddled. They had evidently winded the tiger close by, so we had the buffs in again and were able to advance a few paces over ground made good. Sending some buffs round by the right I at length saw the tigress sneaking among some dwarf date bushes and finally got a clear shot at her.

Now in both these cases the buffs were of not the slightest use in scenting or following up the tiger, but their value came in as a distraction to the tiger's attention and probably also as a means of intimidation. Though they would not have been at all formidable to a fighting tiger, yet he would not have known the difference between them and the much more formidable "daihan" animals, for whom tigers have a wholesome respect and whom they do not venture to attack at random without some very distinct advantage on their side.

(*To be continued.*)

THE EMPIRE FORESTRY ASSOCIATION.

The interest taken in this country in this Association is clearly not large. The number of applications for the pamphlets giving the aims and objects of the Association, with the terms of membership, is almost negligible.

In India forestry is essentially a State undertaking and inspiration in the direction of assisting the Empire Association is obviously the duty of Government. We have looked for action by the Central Government but perhaps it is felt that the real interest in forest matters lies with the provinces and the initiative is left to them. Whatever the cause we hope that India which of all the countries comprising the British Empire has hitherto led the way in the creation of a forest estate and in the conservation, management and utilisation of its forests will not now lag behind in a movement which has the furtherance of both public and technical interest in all forest matters. It is essential to have a central body to link up the local associations and it is equally essential to set that central body on a secure footing from the outset or it will perish and the local associations will languish from lack of cohesion and co-ordination.

We trust therefore that India will uphold the position it has achieved in the front rank of countries which have developed an efficient forest policy. The more so as it is now making a serious attempt to place its timbers on foreign markets.

The Empire Forestry Association has been successfully launched. The inaugural meeting was held at the Guildhall on *November 16th, 1921*. Lord Novar's address which amplifies the aims and objects of the association, which we have already published, is here reproduced at length :—

"The Association which we are inaugurating to-day owes its origin to a Resolution moved by Mr. Lane Poole, the distinguished Forestry Officer of Western Australia, at the Forestry Conference presided over by Lord Lovat last year. Its object is to federate in one central organisation voluntary association, individuals, and corporate bodies engaged or interested in the

growth, marketing and utilisation of timber throughout His Majesty's Dominions.

The promoters of the Empire Forestry Association are naturally imbued with the sense of the practical need for such an association, and of its significance as a new and very effective link of Empire. They are no less alive to the fact that the extent of the undertaking and of the co-operation needed to ensure adequate success requires no ordinary measure of public support.

We have first to record our deep sense of gratitude to H. M. the King for graciously granting his royal patronage, and also to H. R. H. the Prince of Wales for the honour he has conferred on the Association by accepting its presidency (applause). To the Lord Mayor we are much indebted for kind hospitality, and to you, sir, for taking the chair. We would further acknowledge the ready and sympathetic aid given by departments of State throughout the Empire, by the Forestry Commission, the Colonial and India Offices, and the High Commissioners and Agents General to H. M. Overseas Governments. Some may be sceptical of the value and usefulness of voluntary effort, but at any rate all have consented to co-operate.

It is not necessary perhaps to dilate in the City of London on what can be achieved by the initiative and effort of private individuals and voluntary bodies, more especially in these days when we have learnt by experience that Government-run business suffers from lack of personal initiative and from inability to take quick decisions or to secure economical administration. At the same time we must freely admit that in no industry can Governments more hopefully participate than in forestry; in fact forestry is in a peculiar degree an industry in which Government, voluntary organisations, and individuals can most usefully co-operate. The Empire Forest Association should prove a useful intermediary between all these agencies, and should be instrumental in levelling up the knowledge and methods of conservation and afforestation in all the different centres of the Empire. Government Departments cannot interfere with one another. None would brook

being told by another, however tactfully, that its methods were unscientific or out of date. But within our great voluntary organisation such as the Empire Forest Association, *every society and department can pool its knowledge, make known its methods, and make use of the information* and experiences of its fellow members without even acknowledging any obligation. There are knotty points to be solved, and I say with conviction that a quickening of interest in forestry and a general advance in knowledge will be best secured through the co-operation of those who have an intimate experience of local policy and conditions in all British lands, and it is such persons who will form the membership of the E. F. A.

Silviculture, with all its subsidiary manufacturing processes, is the most perennial wealth-producing and employment-giving industry. It can be carried on in all parts of the world, and involves no destruction of capital as does mineral exploitation. Yet *it is the Cinderella amongst industries.* Although arboriculture began in the Garden of Eden, and timber was in demand at the building of the Ark, less is known about it, less science and less money have been applied to its development than to any of the more modern processes of manufacture, such as the growing of cotton and sugar-cane, or the production of rubber and wool.

The forest record of the British race is a poor one. Backward at home, we have destroyed the timber of every continent into which we have penetrated, and the virgin forests in the possession of our race go as rapidly to decay as the stately parks of England. In this country pioneers in forestry have had, from lack of all *sources of information, to learn by costly experiment* and failure, and the planting career of most of us can be traced from many an ill-assorted mixed plantation to the gradually evolved plots on the hill-sides. The English and Scottish arboricultural societies have through their work and publications spread much enlightenment, and the planting owners of to-day need make none of the egregious errors of the pioneer. But these societies are local. They cannot extend their influence to other countries; and though elsewhere there are excellent *institutions doing similar scientific*

work such as the Technological Museum of Sydney, New South Wales, which has made most interesting researches into the properties and uses of the oils and timber of the *eucalyptus*, yet that work is scarcely known throughout Australia, and is probably unheard of in South Africa or in any other part of the Empire.

In the same way, the accumulated experience of the Forest Service of India and the fine work it has done, is shut up in their own sphere of operation, and not one of the societies has been hitherto a lamp to the feet of the pioneer silviculturist.

The losses already incurred are incalculable. The war has accelerated the destruction of our reserves and those of Europe, while the neglect of natural regeneration and unscientific planting have aggravated the situation. Now that the whole world is awakening to the importance of making good the sins of the past and of developing timber resources, now that there is a prospect of much public and other money being expended here and everywhere on forestry, it is imperative that all available knowledge and the result of all scientific research and experiment should be made accessible to the world. It is in order to pool experience, to gather up knowledge and render it easily accessible, to stimulate inquiry, research and experiment, that the Empire Forestry Association has been created. Its business will be that of culling information from all parts of the world, from all experts everywhere and giving it out again to the associated private owners, to institutions and societies, and to central Government departments.

A good deal of spade work has been already done. Affiliation with national and local societies is far advanced. Members have been enrolled under the terms agreed upon, and now that we have our Charter, the first number of the Journal of the Association, which is to become the medium of the exchange of information, will shortly be issued. The Committee appointed by the Timber Trades Federation is actively co-operating with the Empire Forestry Association, in making known its requirements for the development of research, of testing and classifying commercia timbers. It will also help us to ascertain the quantities of timber available, cost, freight, and so forth. This Committee has

inspected the Teddington Laboratory, the Imperial Institute, and anticipates valuable assistance from Professor Faber's new department at the Imperial College of Science and Technology.

The cost of the central society, including the journal, salaries and expenses, works out at £1,500 a year, not an extravagant charge, but of course we enjoy, as always happens in voluntary work, the free use of the experience and knowledge of men having qualification which money cannot always buy.

Thanks to Sir Claude Hill, Colonel Courthope, Mr. Ashbolt, and other overseas and home representatives, the scaffolding of the new organisation is complete and its foundations well and truly laid. Our confident anticipation is that this Inaugural Meeting will, with the help of the members, attract attention and support from all tree growers and those who deal in timber or manufacture it, as well as from those who desire to promote and develop a great source of wealth and employment in every part of His Majesty's Dominions."

"Empire Forestry," the Journal of the Empire Forestry Association, has now appeared and the first number, issued in March last, is before us. The publication runs to 125 pages and is illustrated. The contents include the report of the inaugural meeting to which we have referred above. Mr. Robinson's article summarising the information collected for and the discussions which took place at the British Empire Forestry Conference contains a great deal of valuable information in a highly concentrated form. The following extract from this article shows the estimation in which India stands in the eyes of the Empire in relation to forestry :—

"Perhaps I may be allowed to digress at this stage and pay a small tribute to the share which India has taken in shaping the course of Empire Forestry. The beginnings of Indian Forestry were perhaps incidental to the assumption of the white man's burden, the forests were there and had to be administered in the interests of a teeming and apathetic people. The growing success of the work over nearly half a century is a concrete reminder that forestry is not merely the fad of a few enthusiasts. But more than this the

work—administrative, executive and literary—of men like Schlich, Brandis and a number of lesser known foresters has introduced and expanded before the people of the Empire totally new conceptions of the true rôle of forests in national economics."

There are also interesting articles on Australian timbers, the Australian Forest League and the silviculture of the Eucalypts. Messrs. Pearson and Seaman contribute a paper on Timber Testing in India and Mr. S. M. Edwardes, C.S.I., C.V.O., deals with "Tree Worship in India." Other papers and well selected editorial notes serve to maintain the reader's interest throughout the whole text while Mr. Elwes' review of Professor Troup's book on "The Silviculture of Indian Trees" reprinted from the *Quarterly Journal of Forestry* completes the volume.

We congratulate the Association on this very successful number of its journal.

The interest already awakened in Indian Forestry receives due recognition in this first number of the *Empire Forestry Journal.* We hope that this country will not fail to recognise officially and support an organisation which offers so much scope for mutual benefit among the component parts of the Empire.

NOTE ON TESTS WITH SILVER FIR IN CONNECTION WITH THE USE OF THIS TIMBER FOR SLEEPERS.

The question of using Silver Fir (*Abies Pindrow*) for sleepers after treatment was raised by the Utilisation Circle, Punjab, who requested the Forest Research Institute to carry out tests as to its mechanical strength. This has been done by the Officer-in-Charge Timber Testing on timber supplied by the Punjab. The results of these tests are recorded in the attached statements, which may be summarised as follows, and compared with Canadian Douglas Fir, which used as a sleeper wood, most resembles the timber under investigation.

In spike holding power Silver Fir and Douglas Fir are about equal. With ordinary cut spikes driven into ½ inch holes in

both cases, when withdrawn in the testing machine the average results were as follows :—

	Load at elastic limit.	Maximum Load.
Silver Fir	1,962 lbs.	2,726 lbs.
Douglas Fir	1,956 „	2,718 „

In hardness Silver Fir is inferior to Douglas Fir, the hardness of the former on the tangential surface being 77·5 per cent. of that of the latter.

In resistance to crushing at right angles to the grain Silver Fir is also inferior, its compressive strength across the grain being 63·3 per cent. of that of Douglas Fir.

From the above results, while it must be remembered that the number of test results yet available is rather small, and more complete research may vary the averages slightly, it would appear that creosoted Silver Fir may be satisfactorily used as a sleeper wood provided a 9″ × 12″ bearing plate is used under the rail.

In such work as this, however, a final decision must be based on results of durability tests, and I strongly recommend a test of this kind being carried out in a line where the sleepers will be subjected to fairly heavy traffic conditions with up to 100,000 sleepers or more. I further recommend that this test be made with both 12″ × 9″ and 9″ × 9″ bearing plates, believing that even with the smaller plate Silver Fir may prove satisfactory and economical.

Attached to this report is a detailed statement of results, comparing Silver Fir with a recognised American conifer sleeper wood.

RESULTS OF SPIKE PULLING TESTS ON SILVER FIR (*ABIES PINDROW.*)

Machine 0-30A.

Testing speed 0·0203 inches per minute

Spike No.	Silver Fir (Piece No. 2).	Greatest weight in pounds required to withdraw the spike.	Weight in pounds at E. L.	Weight in pounds at yielding point.
1	Do.	2,315	1,600	2,000
2	Do.	1,940	1,250	1,750*
3	Do.	3,250	2,400	3,000
4	Do.	3,100	2,200	3,000
5	Do.	2,665	1,000*	2,500
6	Do.	3,250	1,750	3,000
7	Do.	2,445	2,000	2,250
8	Do.	3,250	25,00	3,250
9	Do.	2,225	1,900	2,225
10	Do.	2,000	1,500	2,000
11	Do.	3,205	2,000	3,000
12	Do.	2,305	1,500	2,250
Average		2,663	1,873	2,589 (1)
13	Silver Fir (Piece No. 5).	2,425	2,000	2,250
14	Do.	2,750	2,100	2,500
15	Do.	2,300	1,700	2,000
16	Do.	4,035	2,600	3,250
17	Do.	3,580	2,750	3,250
18	Do.	2,710	1,900	2,500
19	Do.	2,870	1,750	2,870
20	Do.	2,575	2,500	2,575
21	Do.	2,275	1,750	2,250
22	Do.	2,940	2,000	2,750
23	Do.	2,500	2,300	2,500
24	Do.	2,500	1,250	2,500
Average		2,788	2,050	2,600 (2)
Average (1)	(2)	2,725	1,962	2,595

* Abnormal results not included in average.

RESULTS OF SPIKE PULLING TESTS ON RED SPRUCE *(PICEA MORINDA.)*

Machine 0-30A.

Testing Speed 0·0203 inches per minute.

No.	Species.	Greatest weight in pounds to withdraw the spike.	Weight in pounds at E. L.	Weight in pounds at yielding point.
1	Red Spruce (*Picea Morinda*)	3,130	2,200	3,000
2	Do.	3,550	2,500	3,550
3	Do.	2,000	1,250*	2,000
4	Do.	3,250	2,000	3,550
5	Do.	2,250	1,600	2,250
6	Do.	2,405	1,500	2,405
7	Do.	2,615	2,250	2,500
8	Do.	2,000	1,500	2,000
9	Do.	1,750*	1,500	1,750*
10	Do.	2,875	1,600	2,875
11	Do.	1,727*	1,000*	1,250*
12	Do.	2,000	1,800	2,000
13	Do.	2,750	2,750	2,750
14	Do.	2,070	1,300	2,070
15	Do.	1,760*	1,160*	1,750*
16	Do.	2,180	1,900	2,180
17	Do.	3,010	2,750	3,000
18	Do.	2,453	1,750	2,250
19	Do.	2,925	2,250	2,925
20	Do.	4,435*	4,250*	4,250*
21	Do.	2,125	1,250*	2,125*
22	Do.	2,920	2,500	2,920
23	Do.	3,250	2,250	3,250
24	Do.	2,805	1,600	2,500
25	Do.	2,265	1,500	2,250
26	Do.	2,830	2,500	2,830
Average of all		2,590	1,939	2,534
Average excluding abnormal results		2,621	1,976	2,607

* Abnormal results not included in average.

SUMMARY OF RESULTS FROM TESTS FOR MECHANICAL AND PHYSICAL PROPERTIES.

Species.	Locality where grown.	Seasoning.	Number of trees tested.	Rings per inch.	Proportion of summer wood.	SHRINKAGE. Volumetric shrinkage to oven dry condition, based on green volume.	SHRINKAGE. Linear shrinkage from green to oven dry condition, based on green dimension. Radial	SHRINKAGE. Linear shrinkage from green to oven dry condition, based on green dimension. Tangential	Specific gravity based on weight when oven dry. On volume when tested.	Specific gravity based on weight when oven dry. On volume when oven dry.	Weight per cubic foot as tested.	Moisture content based on weight of wood when oven dry.
					Per cent.	Per cent	Per cent.	Per cent.			Pound	Per cent.
Spruce (White wood), Picea Morinda.	Punjab ...	Air dry ...	...	...	...	...	...	...	·402	...	28·8	15
Spruce (Red wood), Picea Morinda.	Do. ...	Do. ...	...	...	...	...	...	...	·436	...	31·0	14
Silver fir, Abies Pindrow ...	Do. ...	Do. ...	...	20	39	...	...	...	·393	...	28·4	15·9
Spruce (White wood), Picea Morinda.	Do ...	Do. ...	...	...	...	...	...	...	...	...	...	12
Spruce (Red wood), Picea Morinda.	Do. ...	Do. ...	...	...	...	...	...	...	...	...	...	12
Silver fir, Abies Pindrow ...	Do. ...	Do. ...	...	...	...	...	...	...	...	...	...	12

Black Spruce, *Picea Morinda* ...	Canada ...	*Do.* ...	...	...	...	...	...	...	...	...	...	*12*
Douglas fir, Pseudotsuga Mucronata.	Do. ...	*Do.* ...	...	...	...	...	...	...	...	...	...	*12*
Deodara, Cedrus Libani ...	United Provinces.	Do. ...	...	...	...	...	...	...	...	...	...	...

COMPARISON OF STRENGTH (TAKING WHITE SPRUCE 100 %).

Spruce (Red wood), Picea Morinda.	Punjab ...	...	...	...	...	...	...	...	108	...	108	93
Silver fir, Abies Pindrow ...	Do. ...	...	...	...	...	...	...	...	98	...	99	106
Spruce (Red wood), Picea Morinda.	Do. ...	...	...	...	...	...	...	...	...	...	...	*Taking 12 % Moisture.*
Silver fir, Abies Pindrow ...	Do. ...	...	...	...	...	...	...	...	...	...	...	
Black Spruce, Picea Moriana ...	Canada ...	...	...	...	...	...	...	...	...	...	...	
Douglas fir, Pseudotsuga Mucronata	Do. ...	...	...	...	...	...	...	...	...	...	...	

SUMMARY OF RESULTS FROM TESTS FOR MECHANICAL AND PHYSICAL PROPERTIES—(*contd*).

Species.	STATIC BENDING.						IMPACT BENDING.			
	Fibre stress at Elastic Limit per square inch.	Modulus of Rupture per square inch.	Modulus of Elasticity per square inch.	Work in bending per cubic inch of specimen.			Fibre stress at Elastic Limit per square inch.	Modulus of Elasticity per square inch.	Work in Bending to Elastic Limit per cubic inch of specimen.	Height of drop 50 lbs. hammer causing complete failure of specimen.
				To Elastic limit.	To Maximum load.	Total.				
	Pounds.	Pounds.	1,000 Pounds.	Inch Pounds.	Inch Pounds.	Inch Pounds.	Pounds.	1,000 Pounds.	Inch Pounds.	Inches.
Spruce (White wood), Picea Morinda.	5,415	8,778	1,452	1·15	...	...	11,736	1,893	4·[illegible]6	21
Spruce (Red wood), Picea Morinda.	6,142	10,261	1,584	1·36	...	...	12,817	2,202	4·23	26
Silver fir, Abies Pindrow	5,492	8,567	1,522	1·12	...	...	11,050	1,821	3·79	19
Spruce (White wood), Picea Morinda.	6,390	9,831	1,539	1·43	...	...	13,144	2,007	4·67	19
Spruce (Red wood), Picea Morinda.	6,879	11,082	1,647	1·58	...	...	13,842	2,290	4·65	24
Silver fir, Abies Pindrow ...	6,777	9,903	1,641	1·47	...	...	12,774	1,963	4·53	17

Black Spruce, Picea Moriana ...	6,916	12,215	1,688	1·56	...	...	...	...	...	...
Douglas fir, Pseudotsuga Mucronata.	8,505	13,544	2,103	2·04	...	...	9,833	2,169	2·56	34
Deodara, Cedrus Libani ...	...	...	...	...	...	...	...	...	...	...

COMPARISON OF STRENGTH (TAKING WHITE SPRUCE 100 %).

Spruce (Red wood), Picea Morinda.	113	117	109	118	...	...	109	116	104	124
Silver fir, Abies Pindrow ...	101	98	105	97	...	...	94	96	93	90
Spruce (Red wood), Picea Morinda.	108	113	107	110	...	...	105	114	100	126
Silver fir, Abies Pindrow ...	106	101	107	103	...	...	97	98	97	89
Black Spruce, Picea Moriana ...	108	124	110	109	...	...	...	...	...	...
Douglas fir, Pseudotsuga Mucronata.	133	138	137	143	...	...	75	108	55	179

SUMMARY OF RESULTS FROM TESTS FOR MECHANICAL AND PHYSICAL PROPERTIES—(*contd.*).

Species.	COMPRESSION PARALLEL TO GRAIN.			Compression perpendicular to grain.	HARDNESS. Load required to imbed a 0·444 inch sphere to one-half its diameter.				SHEARING PARALLEL TO GRAIN. Shearing strength per square inch, the plane of failure being		
	Compressive stress at Elastic Limit per square inch.	Crushing strength at Maximum Load per square inch	Modulus of Elasticity per square inch	Compression stress at Elastic Limit per square inch	Radial surface.	Tangential surface.	Diagonal surface.	End surface.	Radial.	Tangential	Diagonal.
	Pounds.	Pounds.	1,000 Pds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Spruce (White wood), Picea Morinda.	3,038	4,487	2,058	668	446	484	490	718	973	1,010	1,073
Spruce (Red wood), Picea Morinda.	3,140	4,614	2,150	678	555	592	617	740	1,258	1,145	1,233
Silver fir, Abies Pindrow ...	4,011	4 699	2,393	459	406	449	...	626	766	707	...
Spruce (White wood), Picea Morinda.	3.494	5,025	2,181	788	459	499	505	783	1,090	1,131	1,202
Spruce (Red wood), Picea Morinda.	3,454	4,983	2,236	759	566	604	629	784	1,359	1,237	1,332
Silver fir, Abies Pindrow ...	4,793	5,432	2,580	566	422	467	...	699	885	817	...

Black Spruce, Picea Moriana ...	*3,866*	*6,501*	*1,797*	*641*	*502*	*570*	...	*674*	*1,209*	*1,441*	...
Douglas fir, *Pseudotsuga Mucronata.*	*4,871*	*7,240*	*2,154*	*895*	*624*	*603*	...	*704*	*1,057*		...
Deodara, Cedrus Libani ...	...	...	...	...	...	...	...	...	...	...	...

COMPARISON OF STRENGTH (TAKING WHITE SPRUCE 100 %).

Spruce (Red wood), Picea Morinda.	103	103	104	101	124	122	126	103	129	113	115
Silver fir, Abies Pindrow ...	132	105	116	69	91	93	...	87	79	70	...
Spruce (Red wood), Picea Morinda.	99	99	103	96	123	121	125	100	125	109	111
Silver fir, Abies Pindrow ...	137	108	118	72	92	94	...	89	81	72	...
Black Spruce, Picea Moriana ...	*111*	*129*	*82*	*81*	*109*	*114*	...	*86*	*111*	*127*	...
Douglas fir, *Pseudotsuga Mucronata.*	*139*	*144*	*99*	*114*	*136*	*121*	...	*90*	95		...

SUMMARY OF RESULTS FROM TESTS FOR MECHANICAL AND PHYSICAL PROPERTIES—(concld.).

Species.	TENSION PERPENDICULAR TO GRAIN. Fibre strength per square inch, the plane of failure being			CLEAVAGE. Splitting strength per inch width of specimen 3 inches long the plane of failure being			SPIKE PULLING.			Consignment number
	Radial.	Tangential.	Diagonal.	Radial.	Tangential.	Diagonal	Greatest weight in pounds required to withdraw the spike.	Weight in pounds at Elastic Limit.	Weight in pounds at Yeilding point.	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.				
Spruce (White wood), Picea Morinda.	389	354	...	...	...	...	...	...	...	...
Spruce (Red wood), Picea Morinda.	396	441	...	...	...	...	2,621	1,976	2,607	...
Silver fir, Abies Pindrow ...	254	238	...	...	...	...	2,726	1,962	2,595	3
Spruce (White wood), Picea Morinda.	401	365	...	...	...	...	...		...	...
Spruce (Red wood), Picea Morinda.	404	450	...	...	...	...	2,621	1,976	2,607	...
Silver fir, Abies Pindrow ...	264	247	...	...	...	...	2,726	1,962	2,595	...

Black Spruce, Picea Moriana ...	*432*	*654*	...	...	...	...	...	...	...	...
Duglas fir, Pseudotsuga Mucronata.	*557*		...	...	...	...	2,718	1,956	...	...
Deodara, Cedrus Libani ...	...	...	...	...	...	...	4,087	3,065	3,970	...

COMPARISON OF STRENGTH (TAKING WHITE SPRUCE 100 %).

Spruce (Red wood), Picea Morinda.	102	125	...	...	...	...	...	...	...	...
Silver fir, Abies Pindrow ...	65	67	...	...	...	...	...	...	...	...
Spruce (Red wood), Picea Morinda.	101	123	...	...	...	...	...	...	...	...
Silver fir, Abies Pindrow ...	66	68	...	...	...	...	...	...	...	...
Black Spruce, Picea Moriana ...	*108*	*179*	...	...	...	...	...	...	...	...
Duglas fir, Pseudotsuga Mucronata.	*145*		...	...	...	...	...	...	...	...

NOTE ON SHINGLES MADE OF "KAIL" AND "CHIR."

(With general information based on actual work carried out at the Imperial Forest Research Institute, Dehra Dun, U. P.)

Wooden shingles for roofing purposes are made from either sawn or split-wood, which if properly treated and good quality nails used, are under most conditions superior to corrugated iron and last as long if not longer. At the same time more protection is offered from heat, leaving buildings covered by shingles much cooler and equally as water-tight as corrugated iron, which substance rusts away where wood smoke gets to the roof, as the acid fumes quickly destroy the zinc coating which protects the iron.

We have on record from Canada many instances of shingle roofs being in satisfactory service for over half a century, and in some cases for as long as seventy-five years, the durability being more dependent on suitable nails than on the timber. A shingle roof requires very little upkeep, and there is the notable case of Bethel Farm, West Virginia, America, the shingles of which still give shelter from sun and rain although they were laid 102 years ago and the nails were hand-made.

Sizes of Shingles, Rafters, Battens and Nails.—With regard to the size of shingles there is no set rule governing this point except that the butt must not be less than 1/3" in thickness which from an economic view allows for the utilisation of short ends of timber which would otherwise be consigned to the scrap heap, but if a standard size can be maintained with the wood available, it is recommended that shingles should be 15" long by 5" wide tapering from ½" at the butt to 1/8" or 1/16" at the thin end. About 700 such shingles will cover 100 sq. ft. of roof area. The width need not be exactly 5" but may vary between 3" and 15". However widths over 5" are not recommended where the shingles are subjected to severe heat conditions.

The rafters from wall plate to ridge should be 4" by 2" and e battens 1½" by 1½".

The nails required for shingles are 1½" long by No. 12 or 13 gauge and of good quality. As the life of a shingle depends to a large measure on the durability of the nail used, it is

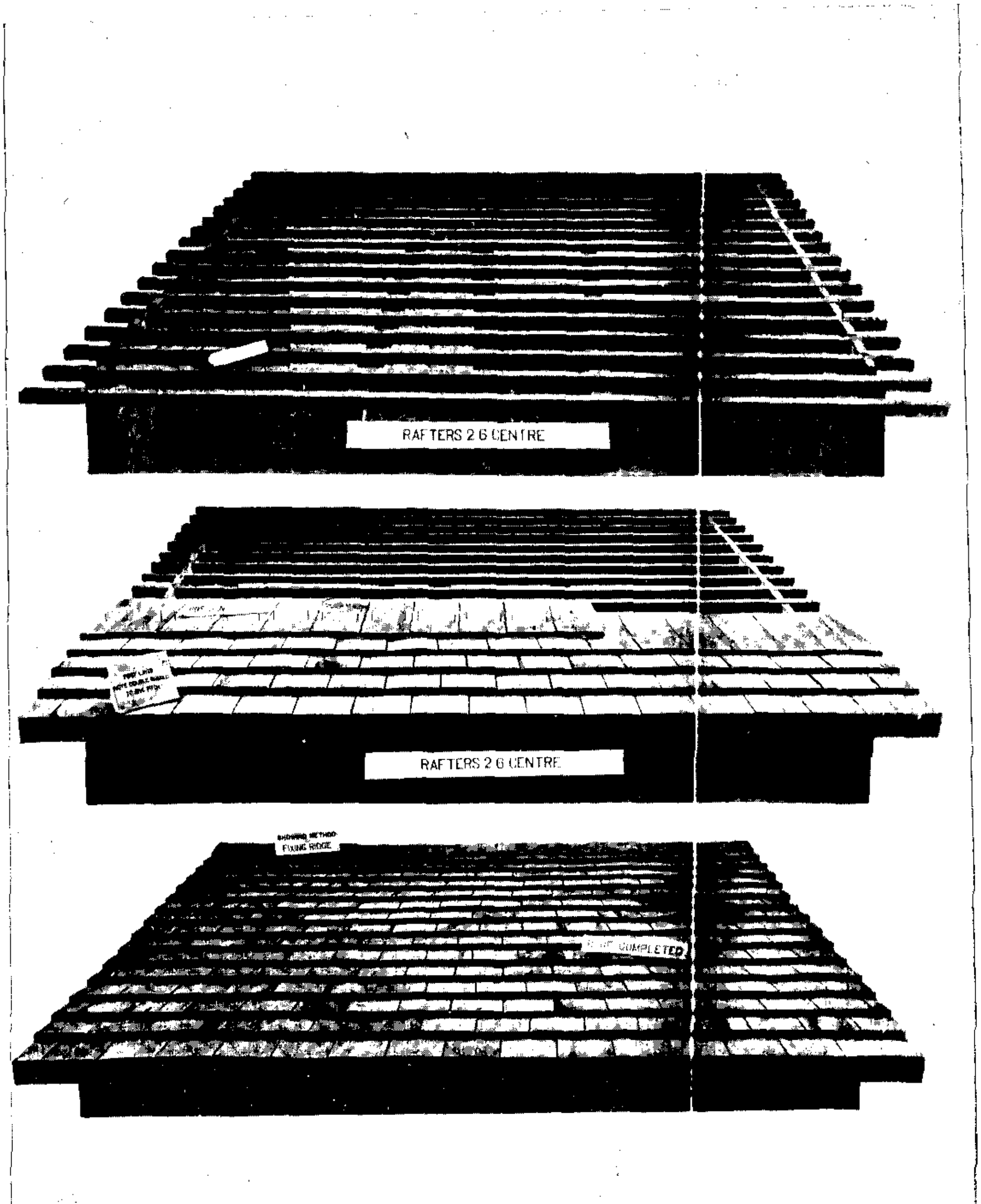

Photo-Mech. Dept., Thomason College, Roorkee.

Shingle Roof under Construction.

advisable wherever possible to obtain nails which have been heavily galvanised, as nails so treated resist the weather better and are not so liable to rust as an untreated nail.

Method of Sawing Shingles.—Where an automatic shingle cutting machine is not available, the method best employed is to first cross cut the timber, which should be air dried as far as possible to prevent cracking, into blocks 15″ long by 5″ thick, or to the maximum thickness of the wood at hand, not under 4″ or over 6″ thick. This done, make a wooden tapered fence for use as a template guide against the permanent fence on your saw bench.

To do this take a piece of timber, preferably hardwood, 2′ 6″ long by 4″ by 2″. Shape a hand grip at one end and from the other end measure down 15″. Strike a line ½″ from edge at end of template to the 15″ mark allowing it to run in taper to 1/16 from edge, cut the piece so marked away from your stick and you then have a tapered recess on one side. The next step is to set your saw bench fence 3″ from saw, place the straight edge of your template against this with the recess nearest the saw, into the recess place the block of wood and proceed to cut the shingles, turning the block end for end after each cut to keep it parallel. By this method of cutting 5,000 shingles have been turned out in one working day of 8 hours by one sawyer assisted by two unskilled labourers on a 24″ saw bench.

Treatment.—After cutting, the shingles, rafters and battens are subjected to the Open Tank treatment, *i.e.*, immersed in creosote oil or a mixture of creosote and earth oil from fifteen minutes to one hour, according to the timber used, brought up to a temperature of 70°C. and allowed to cool down and drain.

Fixing Ground Work.—Spars or rafters 4″ by 2″ are fixed to the wall plate and ridge in the usual way by means of a birdsmouth or any other convenient joint, and set at a distance giving a 2′ 6″ centre between each rafter. (See photograph.) The battens 1½″ by 1½″ are nailed longitudinally across the rafters giving a centre between each batten of 5″. (See photograph.) Care should be taken at this point to see that this ground work lies level and straight, and should be remedied by packing up if any

irregularities occur, otherwise the finished roof will appear wavy and unsightly.

Fixing Shingles.—The ground work thus completed, commence shingling from the wall plate aud continue upwards to the ridge in successive layers the entire length of the roof, with the thick end of the shingles down to wall plate.

The first layer of shingle should be doubled by placing a second layer immediately on top of the first (see photograph), the object of this being to give strength to the shingles overhanging the wall plate, and also to raise the pitch. Having nailed this double first layer to the battens with two 1½" nails in each shingle at 5" from bottom or thick end, *i.e*, in such a position that each line of nails will be covered by the succeeding layer of shingles and so sheltered from the weather, proceed to fix the second and succeeding layers by a rise of 5" to each layer, each shingle of which must cover the joint of the shingles in the preceding layer, which are kept at least 3/16 of an inch apart to allow for the expansion and contraction due to climatic conditions.

When the apex of the roof is reached complete the work by fixing a ridge on top of the shingles lengthwise of the roof.

Cost per 100 sq. ft Shingling (Fixed).—Consequent upon the unstable condition of markets at the moment of writing, it is rather difficult to give a correct idea of costs, but accepting the local rates as a standard, the costs of labour and material to cover 100 square feet of roof space with shingle is as follows :—

	Rs.	As.	P.
Timber	25	0	0
Nails	4	0	0
Conversion labour, power, wear and tear ...	4	0	0
Creosote	2	0	0
Total ...	35	0	0

W. NAGLE,
Wood Worker,
Forest Research Institute.

BURMA NOTES.

Timber Research.—An excellent example of the value of close co-ordination between Provinces and the Central Institute, Dehra Dun, is furnished by recent experience with regard to the question of Economic Forest Research in Burma. During the past year or more proposals for what was referred to as an experimental workshop and laboratory at Rangoon were under discussion. They did not meet with unqualified support from all Forest Officers in the Province and in the working out of the proposals it became apparent that it might serve a very useful purpose to submit them to the criticism of an officer with first hand knowledge of developments in India. The Forest Economist, Dehra Dun, was obviously the man to undertake the task and Mr. Pearson was accordingly invited to come to Rangoon.

The thanks of the Department are due to Mr. Pearson for his visit and the thorough manner in which he went into the various problems to be solved. Before Mr. Pearson left Rangoon, the matter was discussed at an informal Conference of Forest Officers and Mr. Pearson's suggestions were accepted by all officers present. There is, therefore, every hope that Economic Research in Burma will start on a firm basis and meet with the cordial support of all officers in the Department. The following is a brief outline of the final proposals. A more detailed account will be published later on.

Economic Research at Rangoon is to be given the title of the Timber Research Division. It will consist at the outset of the three sections, namely :—

1) Seasoning and Testing of Timber ;
(2) General Purposes Workshop ; and
(3) Sawmill.

Taking the last item first, as only a few remarks with regard to it are necessary, the sawmill will only be a small one capable of dealing with the relatively small quantities of timber required for the various branches of Research. It is not intended that it should cut timber for commercial purposes.

Research in Seasoning is given first place in importance. A battery of three Tiemann Kilns is already under construction for experimental work on artificial seasoning, but it is also intended to conduct comprehensive experiments with regard to air seasoning. When all is said and done, it is not at all unlikely that artificial seasoning will prove to be too expensive for a large part of the outturn of our forests, and that there will always be scope for a considerable amount of natural seasoning. The need for improvement in existing methods with regard to the latter is beyond question.

In conjunction with Seasoning a certain amount of *Preliminary Testing of Timbers* for strength, elasticity, etc., will be conducted at Rangoon. It is not intended to set up a fully equipped section for Timber Testing in Burma at present. This would involve considerable additional expense. It would not appear to be justifiable until it is proved that the Central Institute cannot keep pace *with the requirements of Burma for the Testing of Provincial Timbers*. It will however serve a very useful purpose to have a certain amount of preliminary Testing of Timbers in Burma according to standard methods. The Seasoning Expert must be in a position to test timbers direct from his kilns without the delay involved in sending samples to Dehra Dun. Moreover, it is very desirable that all Forest Officers in the Province should be able to see for themselves how testing is done. There is nothing like ocular demonstration for quickening interest in such a subject.

The General Purposes Workshop, as now designed, will make it possible to undertake manufacture on a limited scale in a number of different directions. Samples of any kind of timber can be converted into whatever form they appear to be suitable for, and samples of the manufactured articles will be submitted to the trade and to parties likely to be interested in them. It is to be hoped that the establishment of the local industries will thereby be stimulated.

But the main idea on which Mr. Pearson lays stress is that this workshop should be designed to serve as a nucleus for future expansion. Instead of launching out at once in a number of

different directions it is better to commence with a single unit and to leave the addition of other branches until experience has been gained. The equipment will be sufficient to permit of all classes of turning and shaping being undertaken (tool handles of all kinds, bobbins, etc., etc.). With a planing machine, small band saw and spindle moulder it is also possible to include a wide range of furniture and fittings for decorative and constructional purposes. Shingle sawing will also find a place. Under the head of future development possibilities are great and hardly need to be specified. The Preservative Treatment of Timber will certainly be undertaken as soon as practicable.

Silviculture.—Interesting results have been shown by the examination of experimental plots laid down early in 1921. Small parallel plots were marked out to show the advantage of coppicing back all stems in two year old plantations of teak and Pyinma (L. *Flos-Reginæ*). The heights of all seedlings were measured last year and all seedlings on half of each plot were coppiced. Remeasurement this year shows that it is only in the case of very weakly seedlings that the actual height of the coppice shoots at the end of the year is greater than the height of the uncoppiced seedlings measured at the same time. In the case of all the more vigorous seedlings the coppice shoots fall far below the height of the seedlings left uncoppiced, though the actual height growth during the year is greater in case of the coppiced shoots in all cases. The comparison after another year may possibly show up more to the advantage of the coppiced seedlings but certainly to the eye the uncoppiced plots now show up much better. The results are similar for the two species planted and also for the natural seedlings of Binga (*Stephegyne diversifolia*) and Thitpayaung (*Nauclea excelsa*) which were present on the plots in some numbers. Results might have been different if the coppiced plots had also been burnt.

Another experiment was made as follows in a teak plantation of 1920. Four plots were made and treated as follows :—

Area fire-protected.

2. „ burnt on 23rd March.

3. „ „ „ 18th April.

4. „ cut in March and burnt on 18th April.

The plots are rather large and are not entirely comparable, but nevertheless the results are interesting. Weeds were exceptionally thick on all the areas.

Plot 2 did not burn very well and the results are poor. The area had to be weeded twice during the rains and the height growth is poor.

Plots 3 and 4 burnt well and there is little to choose between them, apart from the fact that Plot 4 was on a somewhat higher and more exposed situation. It is evident, however, that there was no object in the extra expense of cutting back the weeds before burning. Only one weeding was necessary in both these plots during the rains of 1921.

The comparison between Plots 1 and 3 is interesting. They are not absolutely identical in situation and aspect but they adjoin each other and the great difference shown in the height growth cannot be ascribed to locality. Plot 1 had to be weeded twice at double the cost of the single weeding in Plot 3. In December 1921, it was evident to the eye that the height growth in Plot 3 was much better than in Plot 1. Later, however, weeds came up very thickly in Plot 3 and the difference in growth could not be seen so clearly.

Three areas of 1 square chain each were laid out in each plot in March 1922 and the numbers of surviving seedlings with their heights were recorded. The results show that in Plot 1, although the proportion of survival is higher, 346 out of 363 as against 313 out of 363 in Plot 3, the average height of the surviving plants is only 28″ as compared with 48·7″ in Plot 3. Even the square chain taken in the best part of Plot 1 only shows a height of 38·5″ as compared with a height of 40·5″ in the poorest portion of Plot 3.

It should be noted that the original percentage of survival in the two plots is not accurately known so that the rate of survival cannot be compared, but even if a small number of seedlings have been killed by the fire, the increased height growth in the burnt area has shown the advantage of burning.

A number of 1 square chain plots in pairs on similar localities have now been laid out in one and two year old plantations of

different species and the plants on each plot carefully counted and measured to compare the results of various methods of burning, weeding, etc.

Mr. Dawkins, D.F.O., Zigon, has been engaged in investigating the question of reduced weeding in young teak plantations. In 1920 plantations, after burning in the hot weather of 1921, a very light cutting of the more vigorous weeds only was done during the rains of 1921. The areas have been cut over during December and January and burnt in February 1922. It is hoped in this way to get a strong and early growth of coppice shoots which may be able to contend with the weeds and so reduce the cost of weeding.

REVIEW.

REVIEW OF THE FOREST ADMINISTRATION IN THE PROVINCE OF ASSAM FOR 1920-21.

The period covered by the annual report, having been altered to the financial year, comprises nine months only. For the first time the report has been drawn up for the Province as a whole and in this respect is improved. Any particular statistical information can, however, still be obtained for each Circle separately from the various forms attached to the report.

The most noticeable feature in the report appears to be the inadequacy of personnel and the lack of funds for opening up the country for forest work.

The size of the province is considerable and 5,647 square miles of reserved forests exist. The sanctioned establishment has recently been increased from 13 to 17 Imperial and 12 to 13 Provincial Officers. When it is considered that besides the two Direction Circles there are 12 divisions, most of which consist of 2,000—3,000 square miles of reserved and unclassed State forests even this increase of establishment seems none too great.

The result of this shortage of personnel is shown in Form 11, only 12·9 per cent. of the reserved forests are under working plans

and plans for nearly 50 per cent. are required at the present moment. This is significant when we read that two timber concessions on long lease have been sanctioned, one of them for the Upper Dehing Reserve in the Lakhimpur Division for which no Working Plan exists.

Apart from timber concessions on a large scale, a system of Purchase Contract for smaller operations has been introduced. Under the latter it is customary to auction coupes for a monopoly fee in addition to the payment of royalty at the schedule rates. The extra revenue obtained might well be set aside for the sole purpose of providing a Forest Road Fund. Every 1,000 trees sold at a monopoly fee of Re. 1 should provide at least 1 mile of road, the construction of which would have an immediate result in increasing the monopoly fees obtained at subsequent sales.

The total expenditure on communications for all new works amounted to Rs. 43,379 of which about half was spent in one Division. The smallness of this sum is evident when it is realised that with a total expenditure of 12½ lakhs, a surplus of nearly 7½ lakhs or 60 per cent. was obtained in nine months.

There seems no doubt that the potential wealth of the forests in this province is being realised by the general public, and if money can be made available to provide sufficient personnel and sufficient roads, the budget which to-day shows that the majority of the surplus comes from the unclassed State forests and minor forest produce, should alter considerably and present a statement more worthy of a "Forestry" Department.

As regards silvicultural operations, the experiments with regard to the regeneration of sal in the Western Assam Valley continue, though it is still impossible to draw any definite conclusions. The substitution of grass for the dense evergreen undergrowth by burning is a step in the right direction, but a further difficulty has arisen. The grass is apt to form a thick mat, which falls over to one side and suppresses the young seedlings. The comparison with the zemindari sal areas, where there has been no fire-protection and where grazing is unrestricted

suggests that light grazing shortly after burning may be beneficial. The number of standards 3—15 per acre left on the experimental plots however seems low, and it may be that the rapid growth of the grass can be regulated by leaving more than this number.

The experiments to discover the best method of inducing and aiding the natural regeneration in the evergreen forests have been the subject of a special report and details are not given in the administration report. The statement that the experimental fellings are very promising and that it is hoped that shortly sufficient data will have been collected to form the basis of reliable Working Plans, is gratifying.

Experiments in cutting the "bajal" bamboo *(Pseudostachyum polymorphum)* in the Sibsagar Division at a cost of about Re. 1 per acre are interesting and will be of importance in the regeneration of the areas in which these bamboos are a source of trouble. Apparently one operation is sufficient to exterminate the bamboo. It is of course not possible at present to be certain of this and it will be interesting to hear further on this point, as experience in other parts of India and Burma has shown that bamboos are very persistent.

Tending operations in the sal areas in Goalpara and Kamrup suffered from lack of funds and labour. Considering that some of the finest sal areas in India are to be found in these Divisions this is to be deprecated, especially as the regeneration of this species presents considerable difficulties.

The Taungya plantations in the Lakhimpur Division were not extended owing to an outbreak of influenza and those of the Sadya Division failed through bad seed. It would be interesting to know the probable cause of the deterioration of the seed. Simul is difficult to transplant but as other kinds are also to be used nurseries would probably offer a safeguard in the event of failure such as here recorded.

There are serious difficulties in the matter of transport in the Goalpara Division, 2½ lakhs of cubic feet of timber are awaiting transport to the railway and nearly ¾ of a lakh are awaiting

despatch from the E. B Railway stations. The shortage of railway trucks is doubtless due to the war, but matters appear to have got worse and the action of the railway in demanding wharfage charges from the unfortunate timber traders seems unfair.

The statement that the Assam-Bengal Railway is likely to accept treated Hollong (*Dipterocarpus pilosus*) and Hollock (*Terminalia myriocarpa*) sleepers in the near future is an outcome of an experiment in treating sleepers of these species in 1914-15. The results from the sleepers laid in the permanent-way at Moriani Junction continue to be very statisfactory. Presumably the A.-B. Railway will arrange for an impregnating plant and details of the preservative, cost, etc., will be interesting. There should be no difficulty in meeting a demand of a lakh of sleepers annually as a mature Hollong tree will give from 200 and over cubic feet of timber.

The number of saw-mills of large capacity, which are being erected in this province, the likelihood of treated sleepers being accepted and the general demand by small contractors for timber all point to the fact that the time for exploiting the forest wealth of the province is approaching. This will necessarily mean more systematic working, and unless the preparation of working plans and the construction of roads are taken in hand at once, the full advantage cannot be taken of this demand for timber. The commercial failure of a large concern would put back the exploitation of the Assam forests for many years and it is to be hoped that necessary provision for the requisite staff and money can be made in the near future.

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"LA MÉTHODE DU CONTROLE" FOR SELECTION FORESTS.

As long ago as 1847 the Frenchman Gurnand conceived the idea of managing selection forests by means of an intensive study of the periodic increment, an elaboration of which idea is now called "La Méthode du Controle," but he was considered to be a crank and his method did not find favour. From about 1880 onwards, however, Swiss foresters started to revive the ideas of Gurnand and first put them into practice in the Cantonal forests, of Neuchatel in 1889. Since then other Swiss foresters have adopted the idea in the management of their forests, the leader being M. Biolley who has published a pamphlet titled "L'Amenagement des forêts par la méthode expérimentale et spécialement par la méthode du controle" which explains the method in great detail and recapitulates the results of 30 years' practice. Other articles have been published from time to time in the Swiss Forestry Journal and elsewhere. In his pamphlet M. Biolley claims that the selection system must necessarily be the

best system for those species suited to it—Silver fir in particular—and the arguments which he produces to support this claim have been criticised to a considerable degree in Switzerland and elsewhere. Other arguments in favour of the method however are sound. It is said that the method of control adapts itself to each forest, and is always present enquiring and experimenting with each crop in all that it does, controlling continuously not only what is exploited, but also the result of those exploitations. It therefore aims at guiding but not forcing nature. The silviculture aims at producing the best effects and the greatest production; the management leads, enquires, controls and tests whether or not the silviculture is carrying out these aims and suggests methods for so doing. Silviculture and management are therefore working together hand in hand, which is the ideal in forestry so rarely realised.

It may therefore be said that the objects of the method of control are:—

(1) To furnish a management based on the results of continuous experiments.
(2) To obtain for each tree retained its optimum conditions for growth using the increment as an index.
(3) To balance the silviculture and management in such a way as to obtain the greatest possible returns.

Or, to put the matter more concisely, the aims are:—

(1) To produce the greatest value where possible.
(2) To produce this with the least possible material.
(3) To produce the best quality possible.
(4) And hence as a result of these three to produce the normal forest.

Description of the method.—The first step in the method is to divide the forest material up into two classes—standing trees and felled timber. The former class is of the greater interest to the silviculturist in that it represents the forest in its silvicultural and living state, whereas the latter represents the harvest, the end of the management, and as such is of interest only from a commercial point of view.

However much care be taken in measuring the volume of standing trees, errors must always creep in, whereas the exact volume of felled timber can always be obtained. One is not therefore justified in making the statement that :—

100 cubic meters of standing trees = 100 cubic meters of felled timber.

Therefore any attempt to control a possibility calculated on standing timber by the volume of the resultant felled trees can only be a trap although it is possible that the errors concerned may tend to neutralise each other to a certain extent. In actual practice the volumes of standing trees are usually found by means of volume tables based on height and diameter at breast height, but such volume tables vary with the locality. Hence the converts of the method of control have amalgamated all their local volume tables into one single volume table which they have published under the title of "*Tarif conventionnel unique pour l'application de la méthode du controle*"—see Appendix No. 1—and they have called the unit in these tables *silve* (sv) instead of cubic meters.

The basis of the whole method is a thorough study of the diameter increment put on by trees during the whole of their lives, since this increment represents the result of both the spontaneous and solicited effort on the part of the forest. It is an extraordinarily delicate indication of the growth and vigour of trees and as such must form the subject of continuous study on the part of the silviculturist. Hence enumeration, methodical and repeated, is the fundamental operation of the method of control. The modifications to which the growing stock of a forest is subjected are of two classes—increases and decreases. Increases are caused by the increment and by the entry of new individuals, decreases are due to removals either accidental or intentional. It is therefore necessary to make inventories of the material retained (entries) and of material removed (exits). It goes without saying of course that these two operations, the basis of the whole method, must be made in exactly the same manner, and with the same units if their results are to be of any value.

If the forest is large it is necessary to divide it up into *divisions* or compartments, each of which is treated separately without losing sight of the fact that all form part of one and the same forest. Having then made the above-mentioned inventories, the increment is found by the difference between successive results and forms the basis for the calculation of the possibility and for the plan of exploitation for the next period. This period must be short in fact, the shorter the better, so that alterations in the increment may be realised as soon as they occur; and, where these alterations are unfavourable, the causes may be studied and removed. As regards this question of short periods, it may be remarked that the broad diameter classes of 5 cms. which are used in all the forests managed under the method, are really too broad in cases where the increment is slow for any reason—in fact, small classes would be preferable in nearly all cases. It should be remembered that these short periods refer not only to each division but also to the forest as a whole, *i.e.*, that every part of the forest should be treated at least once in every period. In practice the length of the period varies from 5 to 10 years, 6 being the number most frequently chosen.

The operations constituting a working plan under the method of control are then as follows:—

(*a*) General description of the forest.
(*b*) Division into divisions or compartments.
(*c*) The Enumeration.
(*d*) The Control of Exploitations.
(*e*) The Calculation of the Increment.
(*f*) The Plan of Exploitation.
(*g*) The periodic recapitulation of all the operations carried out.

These operations will now be described seriatim in further detail.

(*a*) *General description.*—Same as in other Working Plans.

(*b*) *Division into Compartments.*—Under this method each compartment is really a permanent experimental plot so that its boundaries must be permanently and definitely laid down once or all. Each compartment should be given a different serial

number, whether the forest contains more than one series or not, so that each forest will contain one complete series of numbered compartments. This method is claimed to be simpler and clearer than the old idea of having the same numbers in different series. Compartments should be homogeneous in stocking as far as possible but it should be remembered that the very short periods tend to cause rapid changes and transformations in the crops. The size should be such that the forest officer can get a clear idea of the compartment as a whole, the ideal being considered by Brouillard to be 5 hect., but Biolley is of the opnion that the size may run up to 15 hect. as a maximum on easy ground.

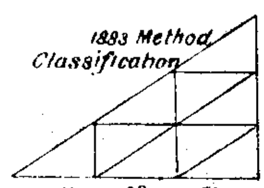
(c) The Enumeration.—The great point about the successive enumerations is that they must be carried out under exactly similar conditions so as to render the results easily comparable. Although not always done, it is better to separate species in the record of the enumeration, in which should be inscribed the diameter and the species, the whole being grouped into 3 classes of small, middle-sized and large trees as follows:—

Small trees—20, 25 and 30 cms. diam. at breast-height over bark.

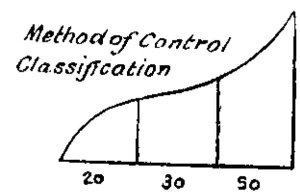
Middle-size trees—35, 40, 45 and 50 cms. diam. do.

Large-size trees—55 cms. diam. and over do.

This classification into small, middle-sized and large groups is made with the idea of judging the composition of the crop and is also useful in the interpretation of the calculation of the increment, and in the markings for fellings. With this classification the normal forest should contain 300 to 400 silves per hectare composed of 20% in the small class, 30% in the middle and 50% in the old. This particular classification is not essential but it is convenient to adopt it in order to render subsequent results comparable with those already obtained. It will be noticed that this classification differs from that on which the French



method of 1883 is based which latter gives 11% small, 35% middle, and 55% large. To this enumeration should be added the special



description of the division, corresponding to the ordinary description of compartments, but containing in addition :—

(1) A criticism of the operations previously laid down and their results.

(2) Any accidents that have occurred.

(3) Suggestions as to the treatment required, particularly as regards the urgency of the operations.

(d) The Control of Exploitations.—This should contain a complete record of all the exploitations which have been effected including the dates, species, volumes, etc. The volumes should be given in silves and also in cubic meters as found by actual measurement of the felled material realised, thus finding a relationship between silves and cubic meters. In making this record care must be taken to separate principal from accessory produce. Under the method of control principal produce is decided neither by age nor by the kind of felling, but by the fact of having been included in the previous enumeration as shown by the blaze on the tree. All trees not showing such marks are therefore accessory. In measuring up felled trees so as to get a relationship between silves and cubic meters, measurements should be made under the bark and down to 7 cms. diameter at the small-end.

(e) The Calculation of the Increment.—This consists in comparing two successive periodic enumerations, taking account of the trees exploited.

Let m be the volume at the beginning of one period.

„ M „ „ the next „

„ E „ „ of the material removed during the period.

„ A be the increment.

Then $A = M + E - m$ in silves.

This gives the increment of the division as a whole, but it is also carried out for classes and species. The calculation is first done with numbers of trees which are then transferred into silves, easiest method of explaining the details is by means of a concrete example, see Appendix No. 2.

From the calculations shown in this Appendix are obtained, for the material present at the beginning of the period :—

(1) The total increment per class of tree and as a whole.
(2) The increment per hectare per annum and the increment per cent.
(3) The passage from one class to the next above it.
(4) *The increase or decrease of the volume of the compart*ment, this being the difference between the total increment and the exploitations.
(5) The effect of the management and silviculture on the growing stock as a whole.

It must be remembered however that this calculation of the increment will never tell the silviculturalist all he warts to know, since, for its real interpretation, an intimate knowledge of the forest as it is must always be the first essential.

(f) The Estimate of the Possibility and the Plan of Exploitation.—Having arrived at a knowledge of the increment what use can one make of it? How can one thereby deduce what is necessary and useful to know for managing the forest of the future? In this matter the method of control adopts a special definition of the possibility in that, for controlists, the possibility has only the restricted sense of being "an estimate of the crop," which may be modified to a greater or lesser extent by a short lapse of time. It is useless and indeed fallacious to fix the possibility for a long time ahead, since such a step ties the hands of the forester, and substitutes for the cultural interest of the coupes, the interest of the volume which must be attained and yet not exceeded. In fact in true silviculture one can have only an estimate of the crop ("*proposition de récolte*") and not a fixed crop ("*imposition de récolte*") as is

so often imagined. The coupe consists in a partial realisation of the crop, and the manner of proceeding to these realisations, their intensity and frequency, greatly modify the volume, grouping and quality of the crop, and by so doing, also modify its increment. It is, therefore, the most vital process in forest culture. Hence the triple question to be asked is: shall the felling be equal to, greater than or less than the increment? Also is the felling more urgent in one part of the compartment than in another? The answers to these questions consist in a personal knowledge of the forest with the increment as an index. The object is to obtain the normal forest, *i.e.*, the forest with the maximum increment, the normal growing stock (fully stocked) and the normal proportion between the age classes. Hence, in the case of the normal forest, the coupe will be equal to the increment in all the stages of the forest, but such an ideal forest is rarely or never seen. In the abnormal forest the idea of the treatment is gradually to lead the forest nearer and nearer to the normal state, without embarking on any rash operations. Therefore where the stocking is in excess the felling will be greater than the increment and *vice versa*: where the grouping is irregular the felling will aim at its regularisation: where the proportion between the diameter classes is abnormal, efforts will be made to reduce this abnormality—in fact every coupe will tend to bring the forest nearer and nearer to the ultimate goal of normality. In making this plan it should be remembered that the first step towards the normal forest is to obtain the greatest forest interest on the forest capital invested and this can best be done by continually favouring the best trees in the crop. Under this method of course one will not get an equal annual yield since one is always striving to increase the increment by reducing abnormalities in the stocking. The equal sustained yield will be attained only when the forest has reached the ultimate state of normality, but irregularities are largely compensated by dividing the forest up into large numbers of small divisions.

(g) Periodic recapitulation.—Although not essential to the method, controlists consider such a recapitulation to be very useful.

It consists of a summary and tabulation of the material present in the forest, of the operations carried out, and their results. It is, therefore, very useful for comparison with the results of similar operations carried out in other forests.

Silviculture of the method.—Silvicultural questions have been discussed all through in describing the method and there is little left to be said. It would appear however that too little attention is paid to the question of regeneration; but this is not the case. The proportion of young trees required in the normal forest is large, 20 per cent. as against 11 per cent. in the French method of 1883, and the method is always aiming at obtaining a better forest and at favouring the best trees. These best trees are placed under the best conditions and therefore should give the best and most seed. The stocking required is the optimum or normal, so that the natural result should be continuous and ample regeneration. In addition, however, the management lays down cleanings, thinnings, etc., by area either in the plan of exploitation or in a separate plan.

Results obtained.—The objects of the method of control have been given above and it is interesting to see how far these objects have been attained.

(1) *To produce the greatest volume possible.*—Graph No. 1 shows the results obtained in the " Forêt de Boveresse " during four periods. It will be noticed that, although the felling has in each case exceeded the estimated possibility, the volume of the growing stock has continued to increase towards the normal.

(2) *To produce this with the least possible material.*—It has already been shown that the least possible material for producing the most possible is the normal stocking of 300 to 400 silves per hectare. Graph No. 2 (*a*) shows how a reduction of excessive growing stock in the Forêt de Couvet has resulted in an increased increment per cent. and an increase in production per hectare. Similarly Graph No. 2 (*b*) for the Forêt de Boveresse shows how an increase in deficient growing stock has also resulted in an increased increment per cent. and an increased production per hectare.

(3) *To produce the best quality possible.*—It is difficult to prove that the method of control produces the best quality timber as well as the greatest quantity, since the expression quality in timber is almost indefinable, but at least it can be shown that quality of produce is not forgotten in the method. Each tree is put as far as possible under the optimum growth conditions the whole of its life, hence the successive annual rings will be approximately equal in thickness— a quality often specified by timber merchants. Also the shape of the tree, *i.e.*, the cylindrical nature of the bole—reflects itself in the percentage of timber ("*bois de service*") to the total volume of wood obtained. Graph No. 3 shows that, in forests managed under the method of control, this proportion has materially increased.

(4) *And hence as a result of these three to produce the normal forest.*—Points (1) and (2) are essentials to the normal forest and their corollary is the normal proportion of the age classes. Graph No. 4 shows the improvement obtained in this respect in the Forêt des Erses after 25 years' management by the method of control. It is anticipated that in about two more periods the proportion will become approximately normal.

Conclusion.—A study of the foregoing amply shows that the method of control is in theory probably the ideal method of forest management. In practice also it has been shown to have given excellent results, but it is impossible to carry out such intensive methods over any but small areas and with any but the best quality staff in sufficient numbers. Some practical Swiss foresters rather scoff at the method as being too intensive, and suggest that one might even attach a detailed history sheet to each tree, or grow it in a glass house! But even if the method cannot be adopted in its entirety for large forests, it at least serves as a model in forest management towards which one can strive if not attain.

F. W. CHAMPION.

APPENDIX I.

GENERAL VOLUME TABLE FOR METHOD OF CONTROL FORESTS.

Circumference: Centimetre classes.	Circumference: Cubes in silves.	Classes.	Diameter: Centimetre classes.	Diameter: Cubes in silves.
20 ...	·01100	Facultative ...	10 ...	·04746
40 ...	·09000		15 ...	·13554
60 ...	·24200	Young trees ...	20 ...	·26974
80 ...	·47200		25 ...	·45248
100 ...	·78500		30 ...	·68619
120 ...	1·27334	Middle aged trees.	35 ...	1·01602
140 ...	1·85455		40 ...	1·42884
160 ...	2·52109		45 ...	1·89764
			50 ...	2·41874
180 ...	3·26542	Old trees ...	55 ...	2·98851
200 ...	4·08000		60 ...	3·60329
220 ...	4·95730		65 ...	4·25944
240 ...	5·88979		70 ...	4·95329
260 ...	6·86993		75 ...	5·68121
280 ...	7·89018		80 ...	6·43953
300 ...	8·94300		85 ...	7·22462
320 ...	10·02086		90 ...	8·03281
340 ...	11·11623		95 ...	8·86046
360 ...	12·22157		100 ...	9·70392
380 ...	13·32934		105 ...	10·55953
			110 ...	11·42365
etc.			etc.	

APPENDIX II.

CALCULATION OF THE INCREMENT.

COMMUNAL FOREST OF BOVERESSE—4TH PERIOD. Area 13·201 hectares.

Tree Class.	Diameters in cms.	INITIAL MATERIAL. Inventory of November 1904 (**m**).		FINAL MATERIAL. Inventory of September 1910 **M**.		Wood exploited during the interval between the two inventories **E**.		Total of **M** & **E** = **MF**.	
		Number of trees.	Volume in silves (**P**).	Number of trees.	Volume in silves.	Number of trees.	Volume in silves.	Number of trees.	Volume in silves.
Big trees ...	100	...		1		...		1	
	90	1		...		...		...	
	85	1		3		...		3	
	80	4		5		...		5	
	75	7		10		1		11	
	70	12		17		2		19	
	65	23		31		3		34	
	60	41		54		2		56	
	55	64		81		6		87	
	A	153	577·18						

				Trees of the class 55 which have passed into the big tree class.					
Middle sized trees ...	50	112		151		15		166	
	45	219		242		23		265	
	40	308		314		35		349	
	35	394		458		61		519	
	B	1,033	1526·87						
				Trees of the class 35 which have passed to middle class.					
Small trees ...	30	613		555		130		685	
	25	772		807		162		969	
	20	1,163		1,050		206		1,256	
	C	2,548	1083·67						
Total of **A**, **B** and C ...		3,734	3187·72	3,779	3540·95	646	463·51	4,425	4004·42
		691	816·70	(Diff. in volume between initial and final results).					
GRAND TOTAL ...		4,425	4004·42	For checking.					

NOTE.—In order to simplify the above the volume of each individual age class have been left out, and only the totals shown.

APPENDIX II—(*concld.*).

CALCULATION OF THE INCREMENT.

COMMUNAL FOREST OF BOVERESSE—4TH PERIOD. Area 13·201 hectares.

Tree Class.	Diameters in cms.	CALCULATION OF THE INCREMENT ON THE INITIAL MATERIAL.							
		The trees of the 1904 inventory (**m**) in the final inventory **M P** with their increment added.		Excess of the superior class coming from the class immediately below.		The difference or the increment of the 6 years, *i.e.*, difference between columns **Q & P.**		The annual increment per hectare in silves.	The increment per cent.
		Number of trees.	Volume in silves (**Q**).	Number of trees.	Volume in s.	For the entire division in silves.	Per hectare in silves.		
Big trees ...	100	1	9·70						
	90	...	...						
	85	3	21·67						
	80	5	32·20						
	75	11	62·49						
	70	19	94·11						
	65	34	144·82						
	60	56	201·78						
	55	24	71·72	63	188·28				
	A	153	638·49			61·31	4·64	·77	1·77 **A.**

		63	188·28							
Middle sized trees ...	50	166	401·51							
	45	265	502·87							
	40	349	498·67							
	35	190	193·04	329	334·27					
	B	1,033	1784·37			257·50	19·50	3·25	2·81	**B**
		329	334·27							
Small trees ...	30	685	470·04							
	25	969	438·46							
	20	565	152·40	691	186·39	Trees from the regeneration coming into the smallest class trees.				
	C	2,548	1395·17			311·50	23·60	3·93	4·79	**C.**
Total of A, B and C ...		3,734	3818·03	Total increment of initial material.		630·31	47·75	7·96	3·29	Total of A, B and C.
		691	186·39	Regeneration coming into small tree class.		186·39	14·12	2·35	·97	
GRAND TOTAL ...		4,425	4004·42	TOTAL INCREMENT...		816·70	61·87	10·30	4·26	

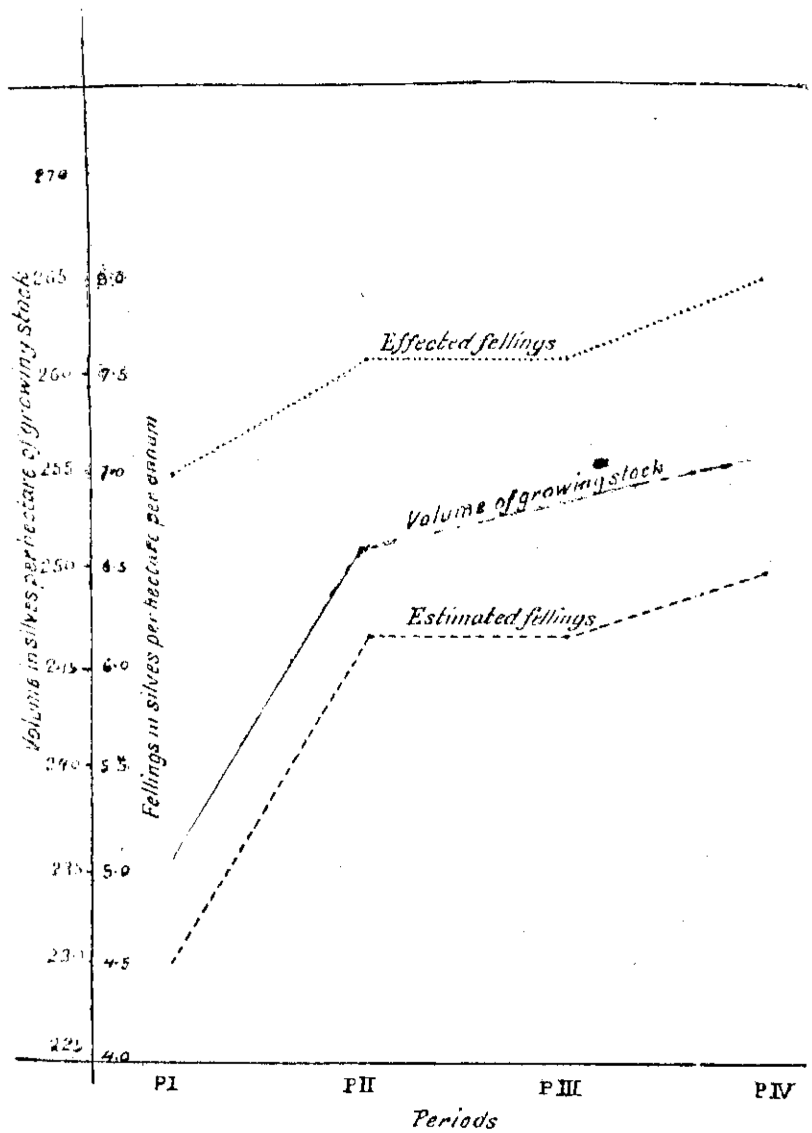
Graph No. 1

Forêt de la Commune de Boveresse.

Result.

To produce the most possible.

This graph shows that although the fellings effected have been considerably in excess of those estimated, the volume of the growing stock has continued to increase towards the normal.



It will be noticed that at each felling the estimated possibility has been exceeded. This is justified by the very short periods under which the fellings are made silviculturally with the estimated possibility as a rough guide. With long periods this would not be possible.

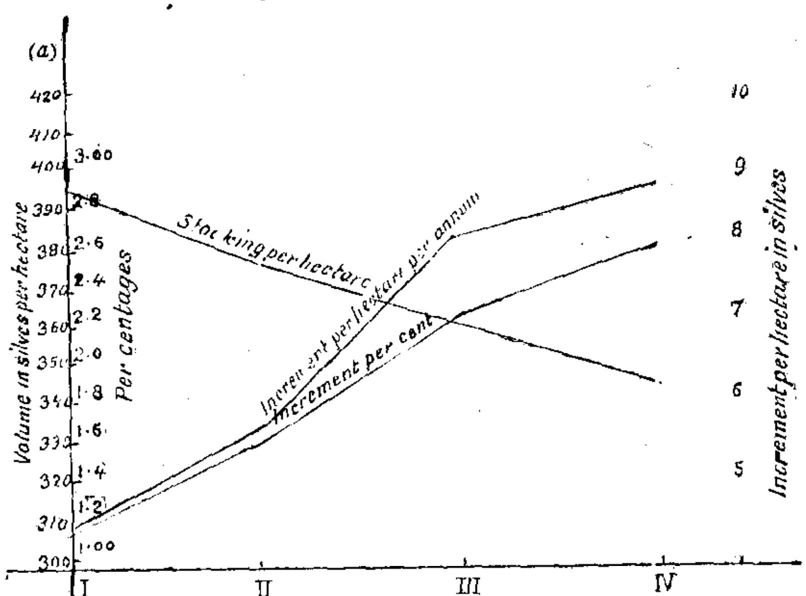
Graph No. 2 (a)

To produce the most with the least necessary amount of growing stock, *i.e.*, the normal stocking.

Result.

Forêt de Couvet
Series I. Div. Ia

(1) Reduction of excessive growing stock causing an increase in increment per cent., and an increase in production per hectare.



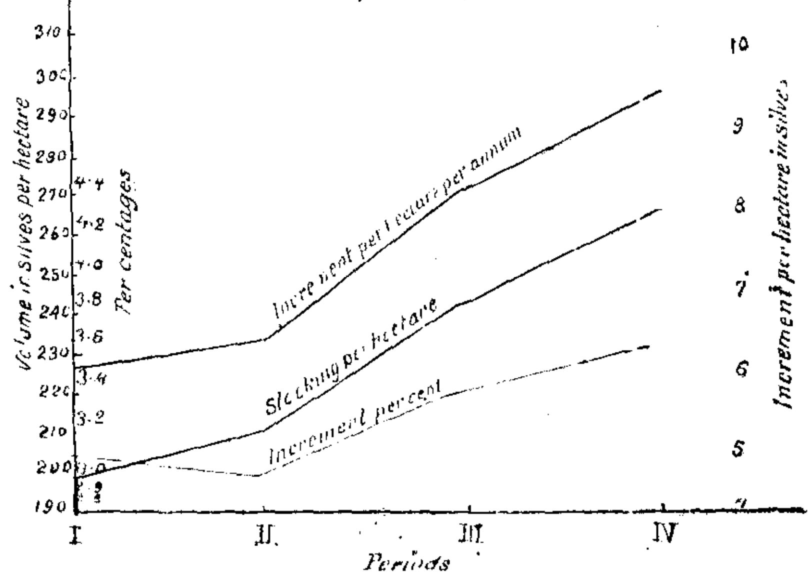
Periods

Graph No. 2 (b)

Result.

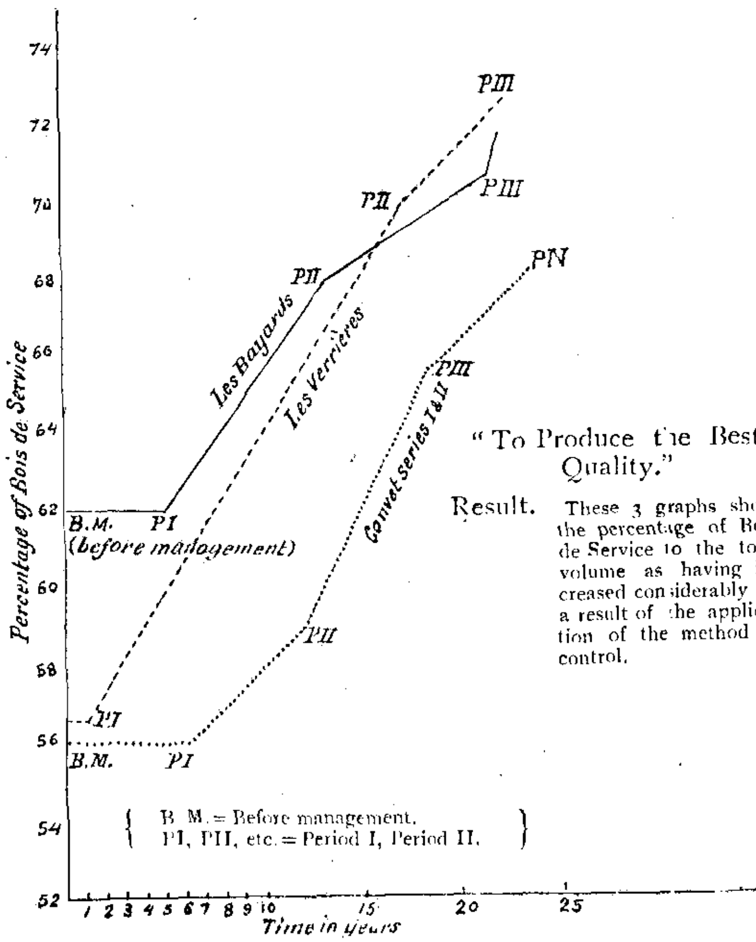
(b) *Forêt de Boveresse*
Div. I.

(2) Increase in deficient growing stock causing an increase in increment per cent., and an increase in production per hectare.



Periods

Graph No. 3



"To Produce the Best Quality."

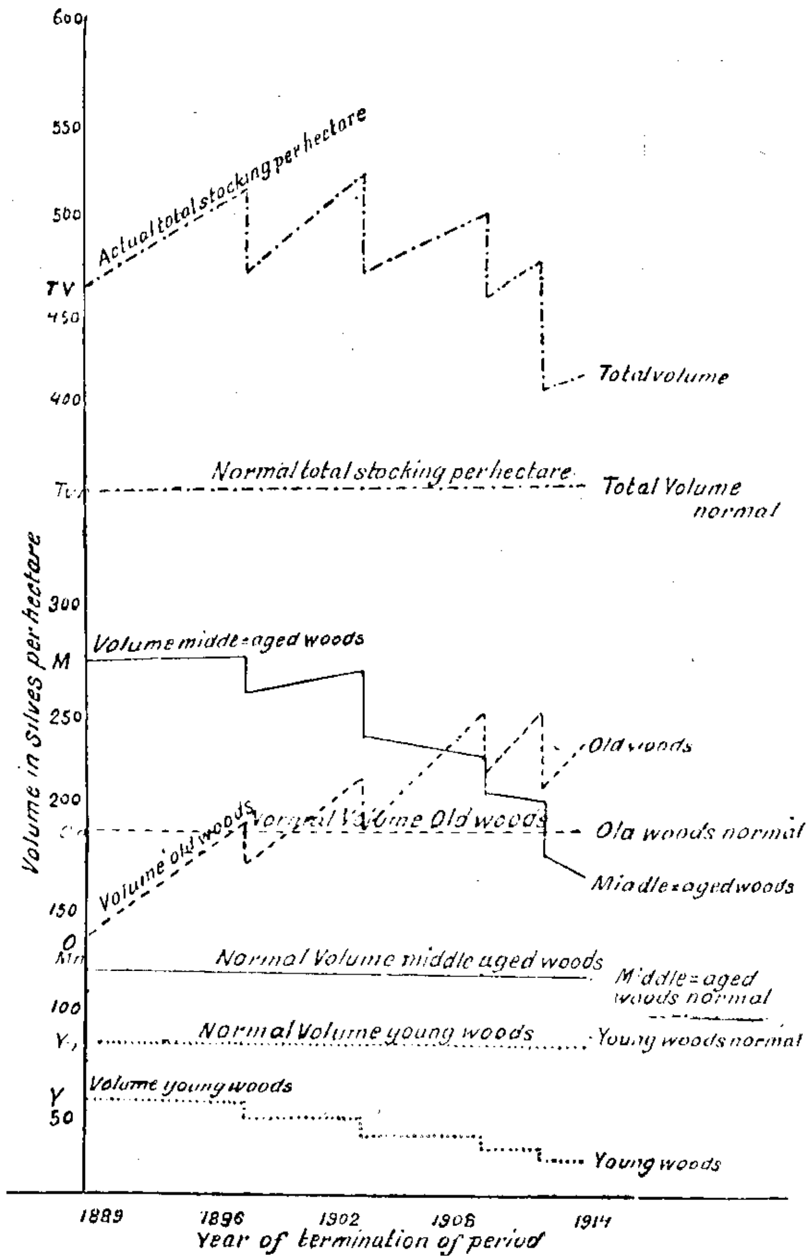
Result. These 3 graphs show the percentage of Bois de Service to the total volume as having increased considerably as a result of the application of the method of control.

Graph No. 4

To attain the normal stocking and normal proportion of the age classes.
Results of 25 years' practice of the method of Control in the Forêt des Erses, Switzerland.

{ Black lines represent the volumes of the actual forest.
{ Red lines represent the volumes of the normal forest.

Result. The volumes of the 3 age classes are much near to the normal at the end than at the beginning of the treatment. There will be a deficiency in the youngest class as long as the forest is overstocked and this overstocking cannot be reduced suddenly.



ARTIFICIAL REPRODUCTION.

(Concluded.)

(4) *Nursery work and direct sowings.*

The importance of good nursery work has lately been insisted on in Bengal, where planting is usually preferred to direct sowing, and the technique of nursery work has been standardised. The authors of the Forest Record already quoted rightly insist on a good site, proper lay out and shading of the seed beds for those species which require this treatment. Their work aims at producing by early sowing, intensive tending and adequate watering plants fit to put out at the beginning of the rains. Coniferous seedlings in the United States are raised on similar lines and in many cases shading the seed beds by lath screens in order to protect the young seedlings from wind and sun has been found to be necessary and is now part of the routine. The question of transplanting in the nursery has given rise to a certain amount of controversy. In Bengal the young seedlings are pricked out as soon as they are big enough to handle. In Jaunsar deodar plants are tended in the nursery for 2 years and 7 months and twice transplanted before being put out in the forest. In Kulu no transplanting in the nursery is ever done and seedlings are put out direct in the forest when 18 months old thereby enormously reducing the costs of planting. It is believed that the present excessive costs of planting in Britain could be reduced by using small seedlings instead of large expensive transplants and that better results would be obtained. *It is significant that the consensus of opinion in Bengal is that* the only safe and successful way of planting is to put out small seedlings.

In other parts of the Indian Empire direct sowing is preferred to planting. In Burma teak sowings are made at a stake 6' × 6' with field crops. In the Punjab plantations a line of Sissu is sown in a step in the ridge and watered by percolation from an irrigation ditch. In ravine plantations of the United Provinces direct sowings are made along the top of the ridges. In Gorakhpur the sal sowings are made in strips on the flat.

In waterlogged areas mounds must be used and Simal plantations in the Tarai made in this way have given very good results. Each locality will develop its own standard methods of doing the work. Costs must of course be kept down to a reasonable level and this fact will influence the method to be employed. The advantages and disadvantages of direct sowing and planting have been frequently discussed. The subject is summed up by Toumey as follows :—

"The history of artificial regeneration shows that direct seeding is the rule and planting the exception in the early devolopment of forestry in every country. Direct seeding finally gives way to planting. This, in turn, has often been carried to excess. At the present time, the foresters generally concede that the particular circumstances of each case should determine the form of artificial reproduction to practise. Planting is generally conceded to be the quickest, safest and easiest known method of restocking. Its economic application, however, must always be a determining factor in its employment. In favourable localities with excellent soil conditions and with acceptable species, direct seeding is usually less expensive. Under the following conditions, however, planting is much more certain and, on the whole, less expensive than direct seeding :—

(*a*) On swampy lands, unprotected areas, sites overgrown with weeds, or grass, and open, heath covered places.

(*b*) Under an open stand of intolerant trees where the soil is liable to become quickly overgrown with herbaceous and shrubby growth.

(*c*) On suitable soil such as shifting sand and water-eroded places ; also on lands subject to inundation.

(*d*) On lands superficially hardened ; on thin, exposed soils ; and on light sandy soils.

(*e*) On lands in mountainous regions subject to slipping under the action of weather and water.

(*f*) In repairing of failed places in both natural and artificial regeneration.

"Frömbling believes that in Europe the advantages of planting and the disadvantages of seeding have been overstated. He believes that dense sowings have a great advantage over plantings, because in the former case competition for space results in the suppression of the poor individuals. When the young stand is crowded the death of numerous individuals results in a welcome exclusion of the weak. As no planting compares in density with a successful stand from seeding, the latter is more fully composed of hardy and vigorous individuals due to the weaker being crowded out. The following principles are set forth by him in reference to seeding and planting:—

(*a*) Only a dense position in early life enables a stand, no matter of what species, to produce the best results.

(*b*) Since in planting the spacing must always be wider than in seeding, the latter is preferable in principle.

(*c*) Special conditions often make the planting necessary If they do not, direct seeding or natural regeneration should be employed.

"Direct seeding is better adapted for the reforestation of recently cut over and burned areas than for afforestation. It is never practicable on sites having a dense ground cover. It is often used on very rocky ground where planting is difficult. In Saxony the direct seeding of Scotch pine and Norway spruce is seldom practised. In Prussia Scotch pine is often regenerated by direct seeding, some foresters advocating direct sowing and others planting even on the same quality of sites and under similar conditions. In Scandinavia where more than one-fourth of the total artificial regeneration is by direct seeding, coniferous forests are re-established by this method at less cost although there is more or less danger of failed places, of irregular height growth, and the overcrowding of seedlings.

"The present low average cost of direct seeding on the National Forests, including cost of seed, rodent poisoning, and the preparation of the ground, *viz.*, $4 per acre, has resulted in a high percentage of total failures and too few plants per acre on sites where failures are not recorded. The present unfavourable results

from direct seeding emphasise the necessity for using the best seed and giving more attention to soil preparation.

"The most important considerations upon which the choice between seeding and planting should be based are the following:—

(*a*) The difference in cost.

(*b*) The difference in the time required for the stand to close.

(*c*) The difference in the quality of the stand."

In India, given a site suitable both for sowing and planting, the cost of formation and maintenance of the plantation till established will determine the method to be employed. In Kulu both direct sowing and planting of deodar are extensively used and there is not much to choose between the two systems. Some trees such as babul and Chir pine cannot be transplanted at all and in such cases direct sowing must be resorted to. Teak is sown in Burma and planted in Nilambore and the exponents of the two methods will both no doubt maintain the superiority of their own practice. In conclusion we have only to remark that provided equally good results are obtained and that the cost reduced to a similar standard for both methods are similar there is no practical difference between direct sowing and planting.

The time of sowing must now be dealt with. Teak seed in Bengal should be sown early in April after special treatment to accelerate germination. The seeds of the *Dipterocarps* and some of the oaks germinate on the trees or immediately they fall to the ground and must be sown at once. Other seeds ripen during the winter and hot weather and do not germinate till the break of the rains. These should be sown either before the break of the rains or immediately after the first rain. Deodar seed can be sown either in autumn or very early spring, sowings of kail and spruce need not be made till the following June. Chir seed is sown in June after soaking the seed in water. "In temperate climates were it not for the danger of being destroyed either by animal life or by adverse climatic conditions while lying on the ground over winter, direct seeding in the autumn would be acceptable for all autumn maturing seeds. All species which naturally

germinate in the spring can be sown either in the autumn or the spring. Seeds which can be easily stored with little danger of deterioration and at small cost are sown in most localities in the early spring. Because of their rapid deterioration when stored, birch, alder and fir seeds are often sown in the autumn."

(5) *Planting.*

In planting work several factors influence the degree of success obtained. The more adverse the local conditions of soil and climate the greater must be the attention devoted to the protection of the site and the establishment of the plantation.

(1) *The Size and Age of Planting Material.*

The planting stock will usually consist of nursery raised seedlings or transplants as planting wild stock is generally unsatisfactory and these wild plants are usually no cheaper than nursery stock. It should be a rule to use the smallest stock which will succeed on the site to be planted. The chief advantages which result from the use of small stock are as follows:—

(1) It is usually much less expensive.
(2) The cost of handling and planting is considerably less.
(3) There is less interruption in growth due to the lifting, transport and planting of the stock.
(4) The root system is less liable to injury.

On the other hand where the planting site is exposed, subject to drought or rank growth, larger plants should be used than on the best sites. The age of the planting material will therefore vary with the site and the species and in most cases cost limits the size of the stock that can be advantageously used in forest planting.* Transplants have a better developed root system but it is doubtful whether this advantage compensates for the enhanced cost of the plantation wherever it is possible to use seedlings. In Bengal where planting is preferred to direct sowing the management aims at producing nursery plants ready to plant

*Toumey—Seeding and planting.

out at the beginning of the rains when 4 to 6 months old. In Kulu, as already mentioned, deodar are always planted out when 1½ years old and transplanting in the nursery is not done.

(2) *Methods of Planting.*

As a general rule the quicker the plantation can be established the cheaper and more satisfactory will the work be, and labour is more economically employed in forcing the plants in their early stages than in keeping them alive once they have had a setback or in replacing a number of casualties. It is often more economical to employ a more expensive method of planting if thereby casualties can be avoided and more vigorous growth obtained.* It is not proposed to discuss the various standard methods of planting as these are well known to all foresters. It is necessary, however, to emphasise the bad effects of doubling up the roots in planting and the disastrous consequences of setting the plant with the collar too deep in the soil. We are only too familiar with both the above faults. When planted the young trees should stand a little above the level of the ordinary soil so that they sink naturally to the correct level, they should never be planted in deep holes below the surface level under the mistaken view that they will obtain more water in this way, and the soil must be well firmed about the roots and not merely stamped down round the collar, neglect of this is another frequent cause of failure. When all other methods fail and the area must be restocked, basket planting may be made but satisfactory financial results can hardly be expected with this costly method. The planting of Sissu root and shoot cuttings is now extensively done with satisfactory results. The cost of setting out the plants is cheap and the growth obtained faster than with seedlings. Attempts to grow sal in this way have however failed.

(3) *The Time of Planting.*

As regards temperate climates Toumey writes :—

" From extended studies by Engler on the periodicity of root growth in silver fir, white and Scotch pine, beech, oak, birch and

* Indian Forest Record, Vol. VIII, Part IV.

maple, it was ascertained that the development and production of roots are not continuous. Root growth is interrupted by periods of repose which do not exactly correspond with those when the shoots are at rest. The growth of the roots of coniferous species was entirely suspended from November to March or April, while root growth in the deciduous trees did not appear to undergo complete arrest in growth even in mid-winter. However, the period from February to beginning of March is the least favourable for root growth, due to the low temperature of the soil. In general, root growth begins its rapid development from a few days to several weeks before its buds start. *For this reason spring planting is more successful when conducted at least one or two weeks before the buds begin to swell. The new root growth will not be injured or broken off in setting the plants.*

"It was found that the roots undergo a cessation of growth in summer due to drought, but in October there is a new period of activity, which is much more intense and more prolonged in deciduous species than in the conifers. It appears from these investigations that the autumn planting of the broad leaved species should be just before this new period of root activity begins. It also appears that deciduous species, because of the greater growth of the roots in late autumn, are more acceptable for autumn planting than are spruce, pine and other conifers.

Almost without exception the most favourable time for planting is the spring, two weeks or more before the buds begin their growth. At this time the roots are active and become quickly established. When plants are taken from the nursery at this time and immediately set in the plantation, there is very little interruption of growth and the conditions are favourable for maximum success. In the spring plantation of deciduous species, it is particularly important that the trees be set before the leaves start their growth or even before the buds have appreciably swollen. When the planting is delayed until the leaves have started, they invariably wither and die on the trees and the later foliage which results from the unfolding of the dormant buds is usually ragged and open. Most conifers on the other hand,

can be successfully planted after the new growth is fairly well advanced. They do better however when set before the new growth has started."

In India the chief planting season for most species is the beginning of the rains. In Bengal the best time for planting is the end of May or the beginning of June for localities above 5,000 feet, the middle of June up to the middle of July in the middle and foot hills, and the same period in the plains except that it is safe there to plant up to the end of August. As a general rule once the rains have properly set in the sooner planting is finished the better, as the more established the plants become during their first rains, the more able they will be to survive their first hot weather. Deodar should be planted as early in July as the rains permit and the same applies to Sissu root cuttings. Walnut both in Bengal and in Kulu is planted out in the cold weather and ash in Kulu is treated in the same way.

(4) *The Spacing of Plantations.*

The spacing of the transplants will vary in accordance with the rapidity of growth of the species employed. The plants must be set sufficiently close to produce a closed canopy at an early age and to form a fully stocked plantation of well grown trees. The disastrous results of planting at too great intervals are only too obvious throughout Britain. At the same time the costs of formation require that the plants be not set closer than is absolutely necessary to produce good results. The planting of larch 6′ × 6′ has lately been advocated in Britain to reduce the very excessive costs of formation under present conditions and when it is considered that this method only requires 1,210 plants per acre compared with 2,722 required for planting 4′ × 4′ the economy is manifest. With a fast growing species we consider that a spacing of 6′ × 6′ will give perfectly good results. This is now the distance laid down for teak in Burma. Deodar should be planted 5′ × 5′. It is better to set the plants square than in rows where the distance between the rows is 10′ or 15′, this delays the closing up of the plantation and produces unbalanced trees.

(6) *Tending.*

"It is becoming more and more clearly established that for the conditions generally prevailing in the United Provinces (the four months of growing season in the rains, followed by four months of dry cold weather, and by four months of hot weather) the success or failure of the plantation depends to a very great extent on the conditions of growth during the first year, and more especially during the first four months of the growing season. A seedling that does not develop adequately during the first monsoon has small chance of surviving the following hot weather.

"Tending of direct sowings and plantations is absolutely vital if failure is not to result. This factor is unquestionably of supreme importance in afforestation, and to its neglect in the past must be ascribed most of the failures in plantation work, with which the United Provinces forest areas are dotted. It has been proved in the plains (Etawah), in the Tarai (Gorakhpur, Kheri, etc.), in the Bhabar (Haldwani, Ramnagar) and in the higher hills (Chakrata, Naini Tal), that failure without rains weeding is almost inevitable and success with rains tending under normal conditions is almost certain. On the other hand with chir pine plantations on bare hill sides near Almora, and Sissu on light gravelly soils with mild weed growth in Ramnagar, success has been obtained without rains weeding, and again in the Bhabar where labour and supervision in the rains are very difficult, various alternative schemes, *e.g.*, early sowing and planting with irrigation, have met with success. But generally speaking nothing can replace or give the same results as rains tending."*

In Bengal the authors of the Forest Record write :—

"The amount of tending necessary depends on the rate of growth of the species and on whether the intervening spaces are occupied by well cleaned field crops or by jungle. Under a good field crop practically no special tending of the forest plants is necessary except the loosening of the soil about their roots, at any rate in the case of fast growing species, provided that two year's cultivation can be arranged for. In the

* The Forest Pocket Book, 1921.

case of sal grown with field crops, some forking or weeding may be necessary and climber cutting will have to be done in the third year. If the area is not under field crops jungle must be kept sickled back well away from the plants, two weedings will be necessary during the first rains, one in the second and one in the third. In the case of sal even more weeding will be necessary.

"Weeding and cleaning is best done at the beginning and the end of the rains. If only one cleaning is to be given it should be at the end of the rains. It is a good plan when making this final cleaning to spread three or four inches of cut jungle over the forked up 'thali' as a mulch and to cover this with a thin layer of earth. Only such jungle as will decay quickly should be used. Illami (*Aggeratum* sp.) forms an excellent mulch and is plentiful. Mulching is particularly advisable on dry ridges into which the roots have not penetrated to any great depth so that the trees are likely to die off through lack of moisture in the dry weather.

The result of this tending is that most of the small trees go away with a straight leader and form symmetrical trees such as are not always seen in plantations set out with one or two year old seedlings."

Troup in his Silviculture of Indian Trees gives instance after instance of parallel sowings, weeded and unweeded, where the former lines succeeded and the latter failed altogether. The tending of sal sowings in Gorakhpur is described as follows:—

"During the rains weeding and working the soil is done generally three times in all. *Weeding is absolutely necessary* or the young seedlings get completely smothered in grass and weeds. Working the soil need not be done with the first two weedings but should be done with the third and final weeding which generally takes place in September. Very good results have been obtained where only weeding and no special working of the soil has been done, as the weeding in itself necessitates some working of the soil. If no weeding is done the sowing is generally a failure. After this tending during the rains it is generally not necessary to do anything more until the next monsoon, provided the work and specially the third weeding in September has been

properly done. The cost of this tending during the first year is about Rs. 12 per acre of actual area worked over."

Trevor insists on the importance of weeding coniferous sowings in Kulu: "It is absolutely essential that direct sowings be properly weeded. Where heavy herbaceous undergrowth is present *weeding should commence on 1st June and be repeated* a second time during August. In other places where the undergrowth is not aggressive one weeding in August will be sufficient Very heavy weedings cost up to Re. 1 per acre. The average cost of weeding 500 acres consisting of both heavy and light work has been found to be 8 annas an acre."

Sissu root and shoot cuttings must also be tended by loosening the soil during the rains. The final soil loosening at the end of the rains is perhaps the most important operation in the plains.

Attention to all these details of management combined with close personal supervision of the work and continued observation as to the best methods to be employed for each and every species will ensure success in artificial reproduction. In many cases already in Burma, Bengal, Nilambore, the irrigated plantations of the Punjab, the afforestation work in the United Provinces and in several hill divisions, standard methods have been adopted on which it would be difficult to improve. Still in other places much remains to be done to bring this branch of our work up to the necessary standard of efficiency. With the increasing intensity of management of the sal forests of the United Provinces, much more artificial reproduction will have to be undertaken for the completion of areas under regeneration, but with the knowledge already obtained this development of our work need give no cause for anxiety.

"TROWSCOED."

SOME C. P. REMINISCENCES.

BY A. W. BLUNT, I.F.S.

(*Continued*).

The Sloth bear is a nasty customer to anyone who comes on him unexpectedly at close quarters. Being very dull of both sight and hearing, it is very easy to stumble on and surprise him, on which, he usually takes the aggressive. One sees cases in all jungly parts, of the most ghastly wounds inflicted by bears, generally on the head, and it is frequently a cause for wonder how the wounded man has survived. Torn scalps are almost common objects while I have twice seen men whose faces appeared broken in two, with a deep gap across them below the eyes from cheek to cheek, across the nose. I suppose the explanation of their recovery lies in the simple lives and hard condition of the ordinary villagers, for their remedial measures are usually of the roughest, and, according to our ideas, of the most septic.

I have seldom taken any trouble to pursue bears and have shot but few, but have had one or two amusing encounters. If two bears come out together in a beat and one is wounded, a desperate scrap between the two almost invariably occurs. The wounded bear turns in wrath on his pal who he thinks has attacked him and he, conscious of injured innocence, retaliates fiercely, both complaining loudly of their hard luck. I once shot a bear which dropped in its tracks, and, as I waited, two little cubs detached themselves from where they had been riding on mamma's back, and began crawling round her. It was impossible to tell before that they were present.

Once H. and I were shooting in the south of Souakhan camping where I shot my first buff as related below. Hearing that there were a lot of bears in the big hill nearby, we sallied forth in the early morning. After a stiffish climb we came on to a great collection of boulders heaped up on the hillside. Looking up at this as we climbed, I saw the head and shoulders of a bear looking down at us, but he quickly withdrew and went to ground. We found in one place a pile of boulders about thirty feet high and

thirty yards in diameter forming a separate hummock on the hill-side. There were marks of bear evidently frequenting this hummock, and living in the crevices, and by listening we could hear bears inside. After considering the possibility of smoking them out, we came to the conclusion that this was not possible as there were too many openings and crevices and no regular cave Finally we put a man on the top with a long bamboo while we stood in suitable positions on either side of the scene. The coolie stuck his bamboo down between the rocks and when he could get no further, waggled it about in the interior of the rocks. Very shortly a complaining rumble was heard and out shot a bear. H. hit it, whereupon it headed straight for me, and I was able to kill it with a shot in the chest. Almost immediately another bear burst out and made down hill and I was able to lay it out before it got away. It was quite an amusing show and reminded me of rabbiting in a biggish bury, as it was impossible to say exactly where the bear would break, and they came out with a hurried pop very like a bolting rabbit.

Once on the march with D. B. in the Melghat, we were told that there was a bear in a hole close by the road. We went to investigate and found that the hole was a horse shoe shaped cave in the bank of a small nala, the two openings of the cave being about three yards apart. We could stand either on the bank above the cave or on the slightly lower bank just opposite, and about five yards from the openings. We unanimously elected the former stand, as I had only a gun with shot cartridges and D. B. a small bore rifle, either a Mannlicher or a Ross, both weapons quite inadequate for meeting a bolting bear. The next thing was to get the bear to show itself. D. B. had his little terrier, Duchess, with him and he put her on to the job. She went in quite willingly and stirred up the bear, who charged out to the entrance and twice showed his grey snout for an instant outside, but withdrew so quickly that neither of us could get a shot. Duchess did her part perfectly three times, but after that, finding that master didn't do his bit, and support her properly, she downed tools and declined to go in again. Then a coolie said he

would get a dog from the village who would go to ground, and a very ordinary little yellow pi was produced who drew the bear two or three times. By this time the bear was getting tired of the game and wouldn't come to the entrance, but demonstrated from inside, so we tried a fresh idea. We got a chaprassi to dangle the end of his pagri down over the entrance. The bear rose like a trout to the new bait and grabbed at the end of the pagri, but he still came short and we never saw more than a grabbing paw once or twice. Finally we left the bear holding his fort successfully against our efforts and went on our march. I may add that an additional interest was lent to the proceedings by the Range Officer, when we arrived on the scene of action, producing a large revolver, which was attached to his person by a chain, and which he waved about during the operations in a most nerve-shaking manner and quite regardless of the direction in which it was pointing.

With panthers I have had a few interesting episodes. I never laid myself out for panthers, but had a go at any beast with a local reputation for destructiveness or cunning. I have found them vary considerably in astuteness. Some are superior to all the usual artifices and stratagems which are employed, though probably they could be circumvented if one could give sufficient time to the subject, while others walk straight out to one in the most artless manner. I found the most likely method for success was to take two or three spare men with one when going to tie up the machan and to make them stroll about in a circle some hundred yards from the kill, talking and tapping trees. This is sufficient to keep the panther on the move and his attention distracted from operations near the kill. When all is ready and you are seated, the whole party move off, talking, and most probably the panther will come out to see what has happened before they have gone a quarter of a mile. The Indian usually tries to tie up the machan silently, which is a hopeless business, and forgets to keep the panther at a distance. The beast can then watch the whole operations from close by and knows what he has to avoid.

Once in Betul I was beating for peafowl with the D.F.O. (R.C. Thomson). T. was coming along with the beaters and I was standing forward beside a small nala under a steepish hill. Peafowl were not materialising and I was looking about me when I saw what appeared to be a stump with an extraordinary likeness to a panther's head in profile sticking out of a patch of grass some fifty yards off and above me on the hillside. There was not a movement of any kind and after having a good stare at it I continued glancing at it for several minutes. Not a move. I then pointed it out to my coolie shikari, who after a look, pronounced it to be a stump. I still kept looking at it at intervals and at last, some four or five minutes after I had first observed it, the soi-disant stump moved and a panther turned and walked back into the grass. I sent the coolie off to tell T. who came up as fast as he could. There was only about three quarters of an hour of light left, so T. went off hot foot to the village to get a goat, while I chose a tree in which I could sit for a short time without a machan. T. came back in due course with a white goat which he pegged out in an open space about twenty yards from me with a big mohwa tree some twenty yards still further on the hillside, and went off talking to the coolies. The goat behaved perfectly and stood looking towards its home and bleating loudly. I waited and the light faded until I could see nothing distinctly except a white patch which represented the goat. I was just going to whistle up T. and his men when I saw apparently a bit of the shadow of the mohwa tree detach itself from the mass and drift slowly and absolutely silently towards the goat.

At the same time I heard T. coming towards me and it was rather a race as to whether the panther would come up to the goat in time, or be scared off. I had to wait as long as possible as I only had my scattergun with S. S. G., and wanted to take the panther as near as I could. At last she (for it turned out to be a female) was within two yards of the goat which was still unconscious of her presence and still bleating steadily, and I fired just above the white patch. To my astonishment the panther went down flat and never moved again and the goat did all

the moving when it suddenly realised that a panther, even though dead, was within two yards of it.

In the first instance the panther was evidently attracted by the sounds of the beat and took up a position to watch, either from curiosity or in hopes that something might come its way. The bundobust worked out to the tick, thanks entirely to T.'s promptitude in getting the goat out of the village. Five minutes delay would have probably resulted in failure.

Later in the same tour, khubber was brought in about noon that a panther had killed a calf about two miles away. T. sent out his men to tie up a machan and I went out about four p.m. to sit up. On arriving I was shown the remains of the calf which had been carried by the panther up a mohwa tree and hung on a branch. It was a large tree some nine feet girth near the base and the lowest branch, on which the remains were deposited, was some thirty feet from the ground. It was the highest and most difficult climb I have ever seen performed by a panther. As far as I could see from below, the forequarters and head were taken up. My machan was fixed in a bamboo clump, of which the central culms had been cut out, standing about twenty yards from the mowha. I didn't feel very sanguine of the result as I was by no means sure that the men had kept the panther off and further. I didn't think that the panther would come and climb this tree again in daylight. However, I settled down to a long wait and sure enough no panther appeared. The tedium was only beguiled towards dusk by two flying squirrels who flew into a tree close beside me and played about for some time. At last, as it got too dark to see I blew my whistle for the men to come up. As the sound died away the panther spoke from a small hill about two hundred yards behind me, and there was a distinctly derisive note in the call as much as to say, "Yah! I heard all your precious preparations and just waited to see if you were fool enough to think you had gammoned me."

I think my most exciting meeting with a panther was at Ambabarwa in the Buldana Division. I went for an evening walk with my chaprassi and a spare cooly and armed with a ·300

Mauser carbine expecting to get a shot at a Kakar. This I did and shot it. The two men slung it on a stick between them and I walked on to get back to the rest house by another path. Just as we turned towards home and topped a slight rise, I saw a panther walking quietly along the path about one hundred yards ahead. I told the men to stop and started off to catch the beast up. I was wearing cotton soles to my boots so I could move very silently on the clean path and I doubled on, full of hope. It is not a chance that occurs often to get a casual panther in the open and I was very keen on the opportunity. Well, I ran on till I was within twenty-five yards, when the panther stopped and looked intently into the jungle to his left, evidently towards some sound he had heard. He offered me a beautiful chance to take him in the back ribs and rake him forward through lungs, and heart, so down I went sitting, got my elbows on my knees, took a steady aim and pressed trigger. Click. A misfire! The panther heard the click, whipped round, saw me sitting there and immediately crouched with his head between his paws looking at me. I worked the bolt quietly and got another cartridge into the chamber, but the situation was now altered. Now the panther was looking at me in a position to spring at once, and only twenty-five yards off, if so much. I had to take him between the eyes, or take a scragging. I wasn't nervous about my shooting so another steady aim and I pressed trigger. Another click! The panther never moved, but remained eyeing me. My temper was now beginning to go and I began to work the bolt with greater freedom as it didn't matter about a little noise like that. My luck was completely out for that day for I had no less than *four* misfires at that wretched beast lying and looking at me. At the fifth attempt the cartridge went off with a very bad hang fire so bad that I was taking the rifle down from my shoulder and the bullet went high over the beast's back. On this he jumped round and disappeared into the jungle. I am afraid by this time my frame of mind was not at all "Sunday schooly" and the epithet for the Bandersnatch might have been transferred to me. It was sickening luck to hit on a bad clip of cartridges at such a moment.

I can't remember having a misfire with this rifle either before or after this occasion, and I had killed a kakar with it only about half an hour previously. So far my luck was out, but it certainly was in when the rifle, having determined to hang fire, hung so long that I missed the panther altogether. If I had only grazed the beast I should have been fairly in the soup.

On another occasion in Balaghat Division I scored badly off a casual panther. I was out for a tramp round after tea, rather with the idea of seeing a fresh piece of forest than of getting a shot at anything, and a chaprassi was carrying my unloaded rifle behind me. I was accompanied by a fox terrier, Jack, whom I was taking care of for a friend on leave. The path I was following crossed one of the rocky outcrops often found in those parts, and led between two of the rocks, the one on the left being about seven feet high, that on the right somewhat lower. Jack was running ahead of me when, just as I had squeezed my way between the rocks, the chaprassi stopped me with a low whistle, pushed the rifle into my hand, and "said, " Panther," pointing to the higher rock. There I saw the beast crouching on the top, with his gaze fixed past me on the unconscious Jack. As the story books say it was but the work of a few seconds to shove in a couple of cartridges and lay him out with a bullet between the eyes. The chaprassi said he caught sight of the panther just as I was squeezing between the rocks, and it was then about three feet from my head. It was so occupied in looking at Jack that it completely ignored my presence as I stopped and turned and fired within seven yards or so from the rock. I think it was decidedly plucky of the chaprassi, having seen the panther, to follow me past the rock and to give me my rifle with the necessary information so neatly and without fuss.

I was able to write home that week to Jack's master and tell him what he had escaped, but alas ! it was only one or two mails later that I had to write and tell him that Jack had, after all, been taken by a panther. I was in the west of the District and was moving camp next day. The carts to take my forward tent and kitchen on were being loaded by the light of a big fire about

twenty yards at most from my tent, and just beyond the fire was a *big pipal tree with a stone chabutra built round it.* At about ten o'clock I let Jack out for a final run round and he had barely left the tent for twenty seconds when I heard a scream from him a wild rush towards the tent, and then silence. We took out lanterns and hunted about with no success, nor could we find anything in the morning except the marks of the panther's claws *where he made his rush and caught Jack up against the tent* Kanat. The brute must have been lying in wait on or beside the chabutra in the flickering light, waiting for anything that he might pick up.

Besides Jack, I have had two other dogs carried away by panthers. One, a puppy, was carried off similarly from the tent door. The third case was rather remarkable. What with my own dogs and some I was keeping for another *friend* on leave, I had six or seven in all. I was camping in the jungle some miles from a village and the dogs were all sleeping with the sweeper chokra in a heap of straw by a fire. In the morning the spaniel was missing and nothing was ever seen of him again except slight marks of a drag crossing a small nala near the tents. The panther had come in, *seized the spaniel, broken his chain, and carried him* off among a heap of dogs and chokra without causing any disturbance or alarm, and then dragged him away actually under my tent-ropes. I could never understand how none of the other dogs were alarmed.

A beat for panther is a very uncertain affair and I fancy they often evade the beaters by getting up trees, but I have ner had actual confirmation of this except in the following case. A panther had killed one of my tiger baits, and as it was near the camp, we had a beat before breakfast. When it was over and nothing had appeared, I went off to camp, while A.K. went off with the beaters to have a drink at a pool a short distance behind my machan. After a short time he turned up in camp and told me that as he reached the water, the panther jumped down rom one of the trees by the pool and made off. He had evidently been sitting up during the beat, probably with a grin on his face.

I have frequently tried sitting over a live goat and even a dog, but my only success was on the occasion as related above. On one other occasion I saw a panther spring on the goat, but I was so bustled by the suddenness of the attack and by my desire to save the goat, that I am ashamed to say that I missed the panther, or rather just grazed him, drawing a drop or two of blood and thus making him still more difficult for the next man.

I have only once been in the neighbourhood of a man-eating panther. This was in Balaghat. The beast's method was to carry off children as they were sleeping in the open on hot weather nights, and I must say his reputation made me sleep with a loaded rifle beside my bed, which is the only time I have ever done such a thing. I had no time to give to hunting him up as I left the district not long afterwards and do not know what became of him.

An episode connected with one of the first panthers I came across was rather ludicrous. I was with L. of the Forest Survey in Chanda and we were camping in the jungle at the foot of a hill from which he was going to observe heliograph signals for triangulation. A few nights previously our camp had been raided by a panther who had carried off a sheep, so when I was awakened by a tremendous hullabaloo about midnight, I knew pretty well what the matter was. As I awoke I was aware of something rushing into the shouldari in which I was sleeping, so, thinking it was one of the goats or some hard footed animal, I shouted for my servant intending him to bring a light and find my slippers rather than risk my bare toes being trodden on. To my great delight the reply to my call came in quavering tones from under my bed and I found that the terrified animal that had sought refuge was my Madrassi chokra.

(To be continued.)

ENTOMOLOGY IN THE UNITED STATES.

The Bureau of Entomology has its headquarters at Washington and is controlled by Dr. L. O. Howard. It contains a number of branches each of which deals with a special class of investigations, one such branch is known as "Forest Insect Investigations."

I should state that the systematic work is done by specialists who remain at Washington and work in the U. S. National

Museum where they have at hand a complete collection of insects and library; their work consists in identifying specimens sent to them by the field workers and others, and in describing technically new species added to the collection. It is found that each specialist can deal efficiently with only one of the larger orders of insects. The field workers are allotted as follows:—

(*a*) Six to Forest Insects. Each is in charge of a field station situated in some important forest area and with a number of subordinate "entomological rangers." The latter are men who, although not scientifically trained, are capable of making observations and guiding control work. The duties of these entomologists consists in biological research and in advising both the Forest Service and private owners.

(*b*) Two men to " Insects attacking forest products." These men conduct research and their advice is at the service of the public. By " forest products" is meant rough timber, finished products and seeds.

(*c*) One man deals with insects attacking shade trees, by which is meant trees growing in parks or on roads.

In addition there are three men who divide their time between (*a*) and (*c*) above.

As a rule the biologic and control work is written up for publication by the field men and the corresponding systematic descriptions are made by the museum specialists.

The Bureau has its own Editorial Office which prepares papers for publication in one of several possible Departmental Bulletins.

Funds are obtained by annual appropriation by Congress.

There is no direct connection between this Branch and the Forest Service, both branches having equivalent status under the Department of Agriculture; active co-operation exists however.

J. C. M. GARDNER,
Divisional Forest Entomologist.
(*I. F. S. on deputation to U. S. America.*)

TEAK REGENERATION.

During the past few years attempts have been made to regenerate the heavier high forest areas of Bombay Presidency which either bear teak, or are fit for teak, by clear felling followed generally by sowing teak seed in patches 6′ apart. The valuable timber is felled and removed in one season (sometimes being previously girdled), and such inferior material (either timber or fuel) as is marketable but has unavoidably been left uncut is felled and removed early in the next season. This latter work has to be finished by 31st December, immediately after which all unsaleable trees and rubbish in the regeneration area are clear felled and prepared for burning. This material should be quite dry by the end of March when it is thoroughly burned. Directly this burning is over patches about 1 foot square are scratched up at every 6 feet and 4 or 5 teak seeds, "treated" or untreated, are dibbled in each patch, and the position of each patch is marked by a stake. The seedlings which result are weeded three times during the rains and are subsequently "mulched." Such is the theory, but in practice comparatively few seedlings have come up to be tended! Consequently the areas have sometimes been reburned and resown, but still with such poor results that the areas have finally been planted up with seedings from a nursery.

The failurès have often been ascribed to infertile seed. While I think there may be some truth in this I doubt whether it is the real explanation of failure for the same type of seed germinates and produces seedlings on the nursery beds. What proportion of seed germinates I do not know. In this connection germination tests of seeds from different localities would yield valuable information.

I am inclined to think that the true explanation of the failure of regeneration by dibbling in patches is that the soil being not sufficiently dug up is poorly aerated and is therefore acid and generally poor as a germinating bed, owing to lack of nitrification, etc. In the nursery the soil is well worked and successful germination follows. Teak seedlings which have

been raised in the nursery and are subsequently planted out almost invariably survive. This I think is because one cannot help working the soil in order to replant the seedling. The earlier in the monsoon that the transplanting is done the better the results.

In discussing this matter Mr. Sane, Instructor, Bombay Forest College, has suggested that ploughing as a preparation for dibbling would be cheaper than scratching patches by hand. In fact it could probably be done for the cost of preparing the marking stakes, already referred to, and which would not be required, for the sowings would be in rows, and for the purpose of weeding the coolies could follow up the plough furrows. We know that the sowing of Tarwad seed in plough-furrows yields good results, and I think this method deserves a trial for regeneration of teak on any cleared area which is level enough for bullocks to work. Strips 18″ wide might be ploughed at intervals of 6′ and seed might then be dibbled along the ploughed strips. Such strips would be well aerated, and so germination results might be almost as good as in a nursery. Then again a ploughed strip 18″ wide would probably remain fairly clear of grass for one season and so cheapen weeding operations which at present, although so necessary, are difficult to carry out in time owing to lack of labour. They are moreover very expensive.

The objection to this proposal is that in many places, though not in all, the soil would be so hard in early April, after clearing and burning is completed, that ploughing would be difficult. In such cases ploughing would have to be postponed until after the first hot weather showers—which in the Kanara high forest areas fall in April. This would mean that the period of aeration previous to sowing would not be as long as desirable, but even so sowings in April, or early May, in tilled soil would probably lead to much better results than earlier sowing on patches which were merely surface-scratched.

As regards steep slopes it would seem preferable that transplanting small seedlings, or larger ones root and shoot pruned, should be made the rule, but if dibbling of seeds is insisted upon

it appears that the patches must previously be worked to a considerable depth so that they may become better aerated.

Much experimental work must have been done in this Presidency and elsewhere which is lost sight of owing to the transfer of officers, so the sooner research officers are appointed the better. We live in hopes that a working plans Conservator will soon be appointed. When he comes perhaps he will give a kindly eye to the subject of gathering together and publishing such useful information as already exists but is not widely known. His assistants might also be able to make experiments and take measurements, etc., while collecting information for preparation of Working Plans, pending the appointment of a whole-time research officer.

H. W. S.

SILVICULTURAL NOTES.

One of the standing conundrums for many years in the U. P. was how to obtain successful natural regeneration of Haldu (*Adina cordifolia*). Last year (1921) some interesting 25 acre experiments were carried out in a first quality sal forest, to stimulate natural sal regeneration. One 25 acre plot (I) was clear felled, one (II) was heavily felled but a shelter wood of 12 standards left per acre, one (III) not felled but burnt, and one (IV) neither felled nor burnt. After the very heavy felling and conversion, the slash and debris was burnt in I and II and burnt fiercely. No tending was done during the rains. There was one Haldu seed bearer in the 50 acres felled over. Apart from the satisfactory effects on the existing sal regeneration, the following results with Haldu regeneration were obtained.

Plots I and II.—Profuse and complete Haldu regeneration, first observed as millions of tiny seedlings in August 1921, chiefly on slash ash-heaps, persistent and decidedly larger in November 1921; leafless and very difficult to find in February 1922, new leaves sprouting April 1922 and every indication of

growing up vigorously in enormous numbers. Seedlings all browsed (by deer), and 1" to 4" high when 9 months old.

Plot III.—Very few seedlings noted, and these only on a narrow belt with heavy side light, which subsequently apparently disappeared.

Plot IV.—Not one Haldu seedling was ever found. These results have been confirmed elsewhere, and point the obvious measures required for successful Haldu regeneration.

In the compilation of a sal yield table for the U. P. some interesting figures have been obtained. The following table is for measurements of even aged and fully stocked crops.

Age.	I Quality. Max. ht. over 110'. Mean diameter.	I Quality. Mean height.	I Quality. No. of trees per acre.	II Quality. Max. ht. 90'—110'. Diameter.	II Quality. Height.	II Quality. No. of trees.	III Quality. Max. ht. 70'—90'. Diameter.	III Quality. Height.	III Quality. No. of trees.	IV Quality. Max. ht. 50'—70'. Diameter.	IV Quality. Height.	IV Quality. No. of trees.	Remarks.
10	2·4	25	1,850	2·2	21	2,020	2·0	17	2,230	1·8	13	2,480	10 years to be added in all cases for period of seedling establishment.
20	4·9	47	690	4·4	39	780	4·0	32	860	3·6	25	960	
30	7·5	64	360	6·8	54	400	6·1	45	460	5·4	36	530	
40	10·1	78	220	9·1	66	250	8·2	55	300	7·2	44	330	
50	12·6	91	150	11·4	75	170	10·3	64	200	9·0	52	230	
60	15·3	102	107	13·8	85	122	12·3	73	141	10·8	56	167	
70	17·8	111	81	16·0	92	95	14·2	78	107	12·5	58	127	
80	20·0	116	66	18·0	97	75	16·0	83	87	14·0	59	103	

A comparison with I Quality oak (*vide* Schlich, Vol. III) shows (1) that for any diameter, I Quality oak and sal are very similar as regards height and number of trees per acre (and hence basal area), *but* (2) the diameter increment of I Quality oak is distinctly slower even than IV Quality sal and bears no comparison with I Quality sal.

The Deputy Conservator of Forests, Porahat Division, Bihar and Orissa, reports the flowering of the following bamboos over a large area in Porahat Division :—

(1) *Dendrocalamus strictus.*

(2) *Bambusa arundinaceæ.*

These are flowering over the whole of the Western Range, the greater part of Central Range and part of Eastern Range, during the current hot weather.

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NOTE ON THE DISTRIBUTION AND HABIT OF *DENDROCALAMUS STRICTUS* AND *BAMBUSA ARUNDINACEA* IN ORISSA.

In carrying out the revision of the working plan for the Sambalpur Division in Orissa and in the course of a recent survey of the bamboo forests of the lower Mahanadi basin the writer noticed certain peculiarities about the distribution and habit of *Dendrocalamus strictus* and *Bambusa arundinacea* which may prove of some interest.

The distribution of *Dendrocalamus strictus* in Orissa appears to be governed principally by the average degree of humidity of the air. This species only flourishes in regions where the relative humidity of the air is low, *i.e.*, in the interior tracts of Orissa which are beyond the influence of the sea breezes blowing off the Bay of Bengal. As the humidity of the air rises this species becomes less and less frequent until in the areas nearest the coast it absolutely disappears. Within the region of suitable humidity the distribution of *Dendrocalamus strictus* is largely determined by the

nature of the soil, and where the latter is residual in origin by the character of the underlying rock. In fact, as little of the forest country is situated on alluvial or derived soils, the extent to which the distribution is governed by purely lithological factors is somewhat remarkable. The species prefers coarse-grained dry soils such as those which are derived from sandstone, granite and granitic, amphibolite, and hypersthene gneisses. It avoids the more moisture retaining soils derived from pure quartzite, phyllite, micaceous schist, quartz granulite and schistose gneiss, The distribution may be locally anomalous in that the species is occasionally not found on rocks where one would expect to find it, but it is never present, expect in poor isolated clumps, on the rocks to which it shows an aversion. The more or less complete absence of *Dendrocalamus strictus* on hill ranges of pure quartzite—which it may be incidentally mentioned yields the favourite soil for sal in Orissa—is a particularly striking feature of the local forest flora. Within its climatic and lithological habitat the distribution of *Dendrocalamus strictus* is somewhat subject to the influence of the physico-geographical factors of aspect and gradient as it avoids precipitous slopes and is generally more dominant on southern and western than on northern and eastern aspects.

In contrast to *Dendrocalamus strictus*, *Bambusa arundinacea* prefers an atmosphere with a relatively high humidity. This species does not occur at all in the driest tracts of Orissa. Proceeding south-eastwards from Sambalpur towards Cuttack and the Bay of Bengal it is first met with in a natural state on the borders of Sambalpur district and then only on alluvial soils in the bottoms of valleys. As the relative humidity of the air rises this species becomes more and more dominant in the valleys and it also commences to invade the hill slopes. It finally usurps entirely the place of *Dendrocalamus strictus* on the hills. Beyond the fact that in the drier regions *Bambusa arundinacea* is found only on alluvial soils, the distribution of this species does not appear to be much influenced by edaphic factors as, within its optimum habitat where the relative humidity of the air is high,

it is just as dominant on dry lateritic soils—though of inferior size—as on deeper alluvial soils. The distribution does not appear to be affected by aspect but on the other hand gradients which are at all steep are avoided.

As far as the writer's observations in Orissa go, on coarse-grained dry soils *Dendrocalamus strictus* generally flowers only sporadically in isolated clumps and not in groups or gregariously. On the other hand on moister soils, which are not however too moist for this species to thrive moderately well,* simultaneous flowering over areas several hundred acres in extent is not uncommon. In or immediately after abnormally dry years gregarious flowering may be induced on all soils, *e.g.*, it is reported that in 1900-01 which was a famine year *Dendrocalamus strictus* flowered over most of the Sambalpur forests.

On alluvial or good valley soils *Bambusa arundinacea* flowers gregariously in the usual regular long cycles, but where it occurs on dry soils as in the more humid regions gregarious flowering takes place at irregular intervals of time, *e.g.*, over dry areas where *Bambusa arundinacea* flowered in 1912-14 the young, still immature, clumps are in flower in the current year. It would appear that, as in the case of *Dendrocalamus strictus*, gregarious flowering of *Bambusa arundinacea* is induced by abnormally dry years provided that it is growing in localities which are susceptible to drought.

On the basis of the above facts, which may or may not hold good for other parts of India, it may be argued that gregarious flowering in long fairly regular cycles was originally characteristic of both species of bamboos. Both species are strong light demanders and it is obvious that in dense forest natural regeneration is likely to be obtained more efficiently if seeding takes place simultaneously than if it is sporadic. In the course of time *Dendrocalamus strictus* has been driven out in the struggle for existence from the most favourable localities for vegetative growth, *i.e.*,

* For example on soils which produce what the writer has termed in the Sambalpur Working Plan the "Khondalite" type of forest from its typically occurring on rocks with which Khondalite is associated.

those possessing deep alluvial soils or a humid climate, and it has become adapted to growing under drier conditions of soil and climate. Under these drier conditions gregarious flowering and seeding is no longer an advantageous feature as the forests are more open in character and sporadic regeneration will not suffer from lack of light. In fact in dry localities a certain amount of shade probably assists the bamboo seedlings to survive and in pure bamboo forest such shade would not be given if regeneration were simultaneous. This theory affords an explanation of the phenomenon that flowering of *Dendrocalamus strictus* by groups or gregariously now only takes place, save in exceptional years, on the more moisture-retaining soils where the forest growth is denser and more evergreen. One would expect to find that on dry lateritic soils, where even in a humid climate the forest is fairly open, *Bambusa arundinacea* would similarly shew a tendency to drop the habit of gregarious flowering and the fact that it has not done so may perhaps be explained by the assumption that its invasion of such dry soils is evolutionarily of recent date and that it has not had time to lose its original habit. The fact that in the case of both species of bamboos the normal flowering habit is liable to be upset by the occurrence of years of abnormal drought does not require explanation as it is only what one would expect.

It would be interesting to know if the above observations on the habit of *Dendrocalamus strictus* are confirmed by experience elsewhere, *e.g.*, through the Central Provinces sporadic flowering should be the rule except on moist soils, while in the more humid climate of the Terai flowering by groups or gregariously should be more common.

J. W. NICHOLSON, I.F.S.

TEAK AS AN EVEN-AGED CROP.

I think many of us, when we inspect teak plantations of over 20 years of age, experience a feeling of disappointment. The quality of timber produced by the individual trees cannot compare with that found in the best type of forest and the doubt must have occurred to many of us as to whether a pure even-aged crop is the best method of treatment for producing the finest quality of timber. So often we find plantations made on localities that are obviously capable of producing the finest teak, as may be proved by the class of trees growing in the vicinity, yet the plantation trees are badly shaped and fluted. Partly, perhaps mainly, this is due to the want of early thinnings, but there may be other reasons for the poor quality of growth in pure densely stocked crops. The same defects that we see in plantations are also seen in the clumps of pure teak that are occasionally found. It is worth considering therefore the conditions in the natural forest which may be considered ideal for the growth of the best quality of teak timber. Apart from the question of locality the best conditions would seem to be plenty of room for the crowns together with a dense under-storey of bamboo. Unfortunately this condition does not allow for the full yield from the soil, the return from bamboo in the greater part of our best teak forests being negligible.

But would it not be possible to produce similar conditions by substituting for the bamboo some timber producing, shade-bearing species of less vigorous growth than teak, which would give a valuable yield at maturity?

During the last three years several Divisions in Lower Burma have adopted the method of broadcast sowing of subsidiary species in their regeneration areas with the teak, planted at stake.

This was originally done with a view to reducing the cost of weeding by the early establishment of a dense stock. The subsidiary species chiefly used for broadcast sowing are Binga (*Stephegyne diversifolia*) and Hnaw (*Adina cordifolia*). Apart from the very great saving in expense in all areas where the

broadcast sowing was successful, the condition of the teak in these areas is now most encouraging. Both of these subsidiary species grow a little slower than the teak at first and cover the soil well. The result is that the soil is kept clear of all weeds and in a cool and moist condition. Binga which is the more successful species will stand a considerable amount of shade but unfortunately does not give a particularly valuable timber. Hnaw on the other hand produces a very valuable timber but is unlikely to stand the shade once the teak gets up. Another species, which has also been very successfully broadcast as a subsidiary species, is Pyinma *(Lagerstrœmia Flos-Reginæ)* and this not only stands shade but gives a very valuable timber. *Unfortunately the locality in which it flourishes is usually on* low-lying areas near streams. What is required is a comparatively slow growing species that does not attain the height growth of teak and throughout its life will keep well below it. Further experiments with the more valuable shade-bearers are necessary. My point is, that, by producing a valuable substitute for the bamboo undergrowth, we can then thin out the teak to very wide intervals at an early age. Twenty feet apart would probably not be too wide for a start, though in view of possible casualties, a somewhat closer spacing might be adopted. It may be urged that from the start the teak might be widely spaced. This I am not altogether in favour of at present, chiefly because we are not yet always certain of getting up a dense crop of the subsidiary species. I know by bitter experience the results of a wide spacing of teak when there are no subsidiary species to assist in keeping down the weeds. The result is invariably increased expense in weeding and a high mortality. My object in writing this note is to suggest to Forest Officers concerned in the planting of teak more especially in Burma that, in planting teak pure in even-aged, closely stocked crops, we are not producing natural conditions and that the results are not entirely satisfactory. Early thinnings are undoubtedly essential but this is not enough. It is not a bit of good taking any steps once the plantation has got up to nearly its full height growth. Teak once it has formed its mode of growth does not seem able to respond fully

to a more open condition. A heavy thinning in a plantation of over 20 years of age which up to then has been kept close usually leads to a vigorous growth of epicormic branches and very little real increase in the size or extent of the crown. The steps to be taken must be taken while the plantation is quite young and before the individual teak trees have formed any particular habit of growth.

H. R. BLANFORD,
Silviculturist, Burma.

SOME C. P. REMINISCENCES.

BY A. W. BLUNT, I.F.S.

(Concluded.)

There was a fair number of buffalo in the nineties on the borders of Bilaspur and Raipur in the Sonakhan and Laun Ranges. I shot four in this part and in three cases had to do a good deal of tracking to finish them off, but in only one case, on the first occasion, did the animal charge. This proportion, I fancy, is contrary to the general experience of sportsmen and I consider that I have been very lucky in the ease with which as a rule I have been able to bag my buffalo. My first experience, however, taught me what an unpleasant thing a buffalo charge may be and I have never lost a profound respect for this animal.

It was about 1891 that I went down to Sonakhan with the intention of having a try for buff, but with no very clear idea of how to put my intention into execution. I had no shikari and had not been able to spot any Forest Guard or local man who professed to know anything about the game. My predecessor had not been a shikari and there was no shooting tradition in the Range. I pitched my camp at a deserted village site about eight miles from the nearest habitation, intending to tramp round the country which I knew from a previous visit was frequented by a fair number of buff. I was waiting in camp until my men had had some food and were ready to start, when a stranger strolled up and salaamed. He was a stout individual, obviously a real jungly

and also obviously somewhat eccentric. Wearing the usual scanty puggree and loin cloth he carried in his hand a small branch, on the tip of each twig being mounted a 'chungi' or leaf pipe of 'tendu' leaves as smoked by all the junglies. He had a pleasant independent air and entered into conversation quite affably. When I told him I was after buff he said there were lots about and he could show me a good herd which was lying up for the day quite close by. If this was true he was a godsend to me, and after a little talk, I engaged his services for a day or two. I am afraid I have quite forgotten his name (I will call him J. for short), but he told me he was a Saonra, one of the aboriginal tribes on the Raipur-Sambalpur border. He accounted for his well nourished condition by the fact that he had lost his wife when he was still young and had not married again, so had been free from the matrimonial troubles which usually wear out others not so fortunate as himself. I employed him on this and on one or two subsequent occasions and found him to be a very fine tracker. He used to bring out a skinny little understudy and between them they would puzzle out the line however hard the ground and never failed to show me the game. A ruffle of the baked surface, a half chewed blade of grass, or the fresh edge of a browsed leaf here and there were sufficient to keep them on the line until more favourable conditions were reached, when they would go on at a fair walk where the ordinary civilised being would just be able to pick the traces up by the greatest care. They were most interesting to watch.

Well, on this occasion we started off in the afternoon towards the promised herd. I wanted a buff and at this stage didn't worry about its being a solitary. We had gone about a mile and a half when we heard the drumming of heavy animals galloping some distance in front and old J. turned with a grin and said, "There go the buff, just moving off to their feeding ground.' On we went, struck their trail, and followed it up. In a very short distance we came to the edge of a shallow depression in the ground where the grass was somewhat greener and at the same moment the herd ran and clustered together and stood looking towards us at a distance of about thirty yards. (I may mention that my

only weapon was a 500 black powder Express in which I was using steel tipped bullets for these thick skinned animals, rather an inadequate article for the purpose, but what to do ?) They showed as a mass of black bodies and heads, crowned by a forest of horns of various sizes, all their noses stuck up in the air in our direction, trying to get an indication of what was approaching. I could not make out definitely if there was a bull present, nor was there any outstandingly massive pair of horns. As a matter of fact there probably was not an old bull present as these usually keep away from the herd and only join them at intervals. In the meantime I had to make my choice as quickly as possible for they wouldn't stay there indefinitely, even with an unknown danger. Old J. had no idea of choosing the best head ; he was out for blood and kept murmuring helpfully in my ear, "Maro, Sahib, maro." The owner of the biggest head available was standing in the second row and the heart and shoulder were covered by a smaller animal in front, but I could get a clear view of the point of the hip and the triangle in front of it, which I was given to understand was a fatal shot. It was not a fair broadside shot, but I could not do better, so I let drive, hoping for the best. At the shot there was a glorious stampede, and by the time smoke cleared away, nothing was left visible, but we could hear the herd galloping off in the distance. We then looked up the tracks and found blood in fair quantities, but the sun had set and J. said it was too late to follow up, so we returned to camp.

We made a fresh start early in the morning, taking up the blood trail from where we had left it the evening before. The country was a sea of grass about knee deep on the drier, harder patches, but nearly shoulder high wherever there was deeper soil. Scattered through the grass were trees, mostly Sáj pollarded and hacked in pre-reservation days. We followed the track cautiously, but at a fair pace through these easy conditions. After about quarter of a mile we passed through a belt where trees were fairly numerous and came out on an open savannah of tallish grass. I semi-consciously made a note that there were trees behind us if required, and we pushed on. We had hardly left the last tree twenty yards behind us, when a large black object rose

from the grass about thirty yards in front and incontinently charged down on us. At the moment it appeared about the size of an omnibus. J. ejaculated something about 'yih áta"! and disappeared from my ken. I knew that my rifle was no use for a charging buff; recalling my mental note about trees, I turned and went on top speed for the nearest. Carrying my rifle in my right hand I seized the tree with my left and swung myself round it. I wasn't a fraction of a second too soon, for, as I steadied myself, the buff, following exactly on my track as I ran, struck the tree with her left horn. As she passed I was just in time to raise my rifle and fire into the upper part of the shoulder; the blade was smashed and down she came on her nose. A couple of bullets into the back of her head finished her and I then had time to collect myself and think. I heard congratulations from above and found that J. and the tiffin cooly had evidently reached the tree before me and got up out of the danger zone. On examining the beast, I found, to my sorrow, it was a cow, and J. told me he had seen a calf run away when the cow charged. However, it was not such a bad mistake for a novice as the horns were decidedly thick for a cow and a well proportioned pair, as far as I remember, eight feet four inches in length.

It was lucky for me in this encounter that the buffalo had not gone thirty yards further before stopping. If I had had ten yards further to run for the tree she would have caught me. I determined after this to strengthen my battery at the first opportunity that funds permitted and so put myself in a position to discuss matters more equally with these larger opponent in the field.

Several times in this corner of Bilaspur I had seen the tracks of a very heavy buffalo bull. I measured them roughly with my hand and found I could just span them which made the tracks as nearly ten inches in diameter as makes no matter. At last I had a chance of going for him. Water was very scarce on one side of his haunts and he was in the habit of drinking frequently at a tiny "jhiri" or waterhole, about the size of my sola topee, scraped by villagers beside a path where it crossed a small nala.

One hot weather morning we arrived in the grey dawn at this jhiri and found he had drunk there during the night. As soon as the buff had left the nala he had got on to hard sunbaked laterite soil on which not even J. could see any tracks, so he had to pick up the line for some distance by examining the bushes and finding here and there a leaf or twig off which the bull had nibbled the tip as he leisurely browsed along on his homeward way. It was a very fine bit of slow tracking, so slow that at times I thought we should have to give it up. However, J. at length worked the line out to an easier surface and then we pushed along fairly rapidly. The buff usually lay up in some fairly dense sal pole forest which gave him good shade in the hot weather. As we got into this, the ground was carpeted with a deep layer of sal leaves in which silent movement was impossible. After we had gone a short distance the bull jumped up some fifty or sixty yards in front, and after a short stare at us, turned and galloped off. It was impossible to get a shot at him among the trees, but I had a sufficiently good view to see that the head was by no means a big one and that it was not worth persevering after, though he was a very heavy bodied beast. I was confirmed in this opinion by other people who afterwards went after him. It was surprising that an animal so heavy in the body and so large in the foot should carry such short horns. I guessed them at not over eight feet from tip to tip.

The best head I got was nine feet six inches from tip to tip across the forehead. I have seen one that measured ten feet two inches and heard of another of ten feet six inches but never had the luck to meet one of this size.

The buffalo in the C. P. appear to have quite adapted themselves to the climate and do not by any means pine for swamps and moist cover in the hot weather. As long as they can get sufficient to drink and some fairly dense cover to lie up in during the day, they do not appear to migrate even a moderate distance to the rivers or other wallowing grounds. Some may do so but several that I knew did not shift their grounds

according to season, at any rate permanently. They may have gone for an occasional change, but their permanent quarters were in quite dry localities.

Wild dogs are quite numerous in many parts of the C. P. and do a great deal of damage to game. It is difficult to say whether or not they are increasing in numbers. I should hesitate to affirm it, because they are such evasive animals, here to-day and gone to-morrow, that one has little evidence for forming an opinion, but my impression is that they have increased since I began my service. Though a wild dog was one of the first wild animals I saw at close quarters, in an early morning stalk, I did not come across many in Bilaspur, Raipur, or Balaghat. I first realised their numbers in Chanda about 1902 and again in the Melghat in 1910-14. In these districts they were very destructive. In 1903 the Chief Commissioner, Sir John Hewett, being satisfied of the damage done by them to the game, raised the reward from Rs. 2 to Rs. 15. I had two trustworthy shikari chaprassies whom I armed with guns and ammunition and told to go out and slay dogs. After about ten days they returned with two or three skins only and reported that the first day or so they got up to the dogs quite easily, but immediately they had been fired at the dogs got very wary and they found their best endeavours were useless. As each skin meant about two months' pay at the then rates, I fancy their failure was genuine. I never heard that the increase in the reward was followed by any great increase in the number of wild dogs killed.

There is some dispute among observers as to whether wild dogs give tongue or are silent when hunting. On two occasions near Ambabarwa in Buldana on the edge of the Melghat, I have heard them giving tongue in the jungle. It was a rather subdued but eager yapping, distinctly audible from the pack running some two hundred yards from where we stood. I afterwards heard the cry of a kakar evidently flying before the pack.

They are reputed never to leave the pursuit of an animal once started before them, but I once saw a half grown nilgai evidently flying for its life across a wide river-bed. Watching for

what had frightened it, I saw three wild dogs come on the line to the river bank and break off the pursuit to drink and lie down in a pool under a rock. I think they had let the nilgai get too far ahead during this halt and I doubt whether they would have continued. I didn't think of waiting to see, but proceeded to lay out two of them on which the third bolted.

I have never got any direct observation of their pursuing and killing tigers, but I have little doubt that they occasionally do so when in sufficient numbers. At the village of Raipur in the Melghat I was once told that a few days previously a tiger was seen making his way across the village cultivation hotly pursued by a pack of dogs, one of which jumped on his back and hung on for a bit. Two of the villagers, going out to cut grass shortly afterwards, saw the tiger up a tree with the pack sitting below. On the appearance of the men the meeting broke up, the tiger jumping down and the dogs following again on his track. The story was told me in the most matter of fact manner and I have no doubt that the incident occurred as described. I got the two men to show me the tree. It was a small palas with a horizontal branch about eight feet from the ground, altogether a most inadequate perch for so large an animal. I got up and examined the branch and could find no traces of hair which might have caught in the bark, but its absence after an interval of ten days or so cannot be taken as evidence against the truth of the story.

That wild dogs do not funk a tiger is evidenced by the following incident which was told me by my friend, "Crow," who witnessed it. He had kills tied out round his camp and on very early Khubber being brought in that one of the kills had not been taken, he went out in that direction with one gun bearer to look for sambar, etc. On his way he passed the buffalo still alive, but when he had gone some two hundred or three hundred yards further, the gun bearer stopped him and said, "Sahib, that kill has been taken." He turned back and approached it cautiously, when he saw a big tiger lying on the buffalo, while a few yards beyond sat a semi-circle of wild dogs looking at the tiger. "Crow"

sat down to watch the proceedings unnoticed by either party. As he described it, the dogs would gradually edge forward inch by inch contracting the circle until the tiger would rise and demonstrate with a snarl, on which the dogs would fall back again. This happened two or three times and "Crow" was waiting to see what would happen, when all was disturbed by the shikari and coolies coming out to give the buffalo its grass and water. On hearing them approaching the whole show broke up in disorder and "Crow" was left lamenting what might have been an almost unique chance of observation.

Once in Raipur district I was sitting in my tent on a hot weather afternoon. I had chafed my heel which had festered and I was only able to hobble about in slippers. I became aware that our dogs in another tent and the crows in the trees overhead were barking and cawing evidently disturbed by something close by. I went out and there, within thirty yards of the tents, I saw a pack of wild dogs engaged in devouring something. I got back as quick as I could, picked up my rifle and four or five cartridges which were lying handy, and hobbled out again. By this time the wild dogs were drawing off towards the forest, and were some sixty or seventy yards away. I opened fire and used up all the cartridges I had brought, but unfortunately made a series of clean misses. There must have been about twenty dogs in all, and the pack consisted of about half the number of full grown dogs and half obviously immature and somewhat smaller pups. The action of the pack was remarkable and thoroughly organised, for the older dogs evidently sent the pups on to get them out of reach first, while they themselves turned and retired more slowly, snarling and chattering at me to cover their retreat. I have never heard of wild dogs attacking man, but their behaviour on this occasion made me think that if I had been able to run up to closer quarters it would not have taken much to induce them to attack me in defence of their young. If they ever did so it would be a most unpleasant experience, for the snapping bite of a wild dog inflicts most ghastly wounds. I have seen an unfortunate sambar hind pursued close past me by a single big male

dog, bleeding from terrible gashes in its sides and flanks inflicted while the dog was running and leaping beside it. I missed the dog with a 220 Winchester I was carrying, but the shot made it leave the pursuit and the hind got away for the time into the forest, but I fear the respite was only a temporary one and the dog was probably after it again almost immediately. I may add here, that after the incident above related with the pack, I examined the spot where they had been eating their kill, but could not find even a hair to indicate what animal they had run down. Whatever it was they had completely demolished it within about three minutes.

The wild dog is said to be quite untameable even when caught young and brought up in captivity. Once in Betul some men brought in three puppies probably about a fortnight old. I didn't want them but our Khansama gave the men a trifle for them and reared them for some time. When I last saw them some six weeks or two months later, they would follow him in the compound and evidently looked to him as the provider of food, but did not care to be handled much even by him, while they shrank and ran away from everyone else. A few days later I asked him how they were getting on and he said they had developed rabies and he had destroyed them. I believe that he had thought that he could make something out of them by selling them to some Zoo, and then finding on negotiation that there was no profit to be made, he destroyed them. He was a considerable pice hunter and I never believed that he took the little beasts from other than mercenary motives.

In the article on the sambar in the "Fauna of India" no particular distinction appears to be made between the sambar of India proper and the sambar found in Assam, beyond recording that the Eastern sambar develops a shorter, stouter horn. (I write here from memory, but this is about all that is said.) It appeared to me from my small experience in Assam that there were more points of distinction than this. The Assam horns are much shorter, more upright and less spreading than the C. P. type. They are very thick and rugged, much less graceful and

make a very inferior trophy. In the C. P. one often comes across a small troop of hinds with their fawns associating together up to eight or ten in all. In Assam I have never seen more than one hind with her butcha. Again the alarm note of the C. P. sambar is a deep explosive note very like a short blast on a deep toned bugle. In Assam the alarm note is thinner and shriller rather resembling the cry of the chital though more powerful.

When I went to Assam I was asked if I could account for the raw patch on the sambar's throat. I didn't know what was meant until I had shot a sambar when I found, that on the front of the throat was a bare patch about the size of my hand, with a raw patch the size of a rupee in the middle of it. It had the appearance of being rubbed as if some parasite in the skin caused an itching at this spot. I only shot two or three sambars in Assam as the trophies are poor and there is no fun in shooting an animal that stands within thirty yards gazing stupidly at your elephant, but in every case I found the same phenomenon and I was told it was invariable, I have never seen or heard of any explanation. I think I am right in saying that this does not occur in the C. P. sambar.

On several occasions I came across wolves in Chhattisgarh. The first time I was riding in the afternoon from Bilaspur to my camp some fourteen miles out. When crossing a wide open stretch of "bhata" land I saw two animals in the distance, coming towards the road, which I took at first to be jackals. As we drew nearer together they grew larger and larger till I made them out to be wolves who would cross the road a little ahead of me. I stirred up my pony and galloped on to try and meet them, and managed so that we all reached the same point of the road together. The wolves were in no way disturbed, but one squatted on his hunkers on the near side while the other crossed the road and turned and looked at me. My pony was a puller and we galloped between the two wolves within fifteen yards. They never budged till I was well past, when they got up and sloped off.

Once I was marching in to Raipur from Arang. I was riding a small pony who was quite fast for a quarter mile sprint and was

accompanied by a big greyhound, Pongo by name. I saw a wolf crossing the road two hundred or three hundred yards ahead, so I galloped and laid Pongo on. He sighted the wolf at once and went off as hard as he could. By the side of the road was a strip of uncultivated black cotton soil full of holes which made very bad going for about two hundred yards and I was left behind. When I got clear of this I followed up and came on a small dried up "dabri" or tank with a low bund round it. In the bed of the tank was Pongo with an entirely detached expression and air, as much as to say, "What on earth did I come to this rotten place for?" while on the far bank sat the wolf looking down on him with a sardonic grin. On my appearance the wolf got up and loafed quietly away, so I set the pony after him and tried to lay Pongo in again. He, however, wasn't taking any more wolf and declined to do more than gallop alongside me, so for about half a mile I went as fast as the pony could go over sound going and watched the wolf moving. One reads of "the wolf's long gallop," but his action conveyed to me the idea that he was lobbing along at the slowest possible canter compatible with keeping out of a trot. It was the easiest, most leisurely movement I have ever seen, though Pongo was going a good twelve annas to keep with me. The wolf evidently enjoyed it and despised our efforts, for he kept glancing over his shoulder to keep his distance about twenty-five to thirty yards in front. After about half a mile of this I was pulling up when Pongo spotted a jackal a little off our line and went after it full split. I pulled up and the wolf did the same and sat down about forty yards from me watching Pongo run into the jack and bowl it over two or three times, the jack yelling blue murder. While this was going on I saw another wolf coming towards us about two hundred yards away. I thought it was time to get Pongo in, as the two wolves could easily have got at him and laid him out before I could interfere so I called him in and we made our way back to the road.

I read years ago in the "Pioneer" an account of a wolf being run down and killed single handed with a hog spear. As far as I remember it was done by a light weight rider, well mounted on an Arab and the distance estimated to have been covered in the chase

was about eighteen miles. It was a matter of endurance and at the finish the wolf just lay down to be speared, completely done out. From what I saw I am convinced that no horse could extend a fresh wolf across country in a short burst.

I was marching one day in Raipur district along the forest line to the west of Dhamtari. The forest is very poor and scanty on the sandstone ridge and visibility is generally fairly good. I saw two wolves approaching the forest and from our relative speeds I hoped they would cross the boundary fairly close to me. However, they saw me and my following of three or four men and quickened up so that they arrived on my path about two hundred yards in front. I had got my rifle ready and just before leaving the line the wolves stopped and stood looking at us, so down I sat and took a careful aim. At the shot the wolves turned and bolted into the forest and were covered by scrub. As they turned I saw that I had scored a hit as the foreleg of one was swinging and he scrambled rather than ran. On reaching the place to pick up the blood trail I found lying on the ground a hind'eg shot off just above the hock. I thought that even a wolf, if on two legs only would be possible to pick up, but we entirely failed. We followed the blood for a short distance when it stopped, and though we cast all round in the grass and thorns, we could find no further signs of the animal who had evidently managed to scramble along for some considerable distance or had got into some thicket where he avoided us. I had no dog at the time who could have helped in tracking. Brer wolf is a tough nut.

These incidents occurred at long intervals and it must not be imagined that wolves were very numerous. Nor did I ever hear of their taking to man, or rather child, killing, as the wolves in Hoshangabad did in the nineties when the late Harry Playfair of the Police had to be put on special duty to destroy them.

In Chhattisgarh we got very large flocks of Koolan, generally the Common Crane. I have once seen and identified the Demoiselle though I have never shot one. The cranes feed in the mornings on the wheat and gramfields, and rest during the middle of the day on sand-banks in the big rivers, as the Mahanaddi,

Siunath and Pairi. About the junction of the Mahanaddi and Pairi I have seen and heard thousands of Koolan in the air at the same time. When resting on the sand-banks it is sometimes possible to approach a flock by drifting down in a dug out and on one occasion on the Siunath, I got five with a double shot from a shot gun.

Though the Koolan is so gregarious and is never seen in family parties like the sarus, its feelings of family affection seem to be no less highly developed. I once stalked a flock of Koolan feeding in a field with my 220 Winchester, and at the shot a bird fell. The flock flew off, but as I was picking up the bird, another crane separated from the rest and came circling back over me and I was able to bag it with my shot gun. It was evidently the mate of the bird I had first killed, and, though I didn't consider it in that light until afterwards, to shoot it was probably the kindest thing I could have done.

On another occasion I stalked a flock with my shot gun and hit one bird heavily with a long shot. It fell to the ground but was able by half flying and half stumbling along, to keep ahead of me as I ran over the shingle to try and despatch it From the flock two cranes turned back and flew very low over the wounded bird evidently encouraging it to struggle on and to such good effect that at length it was able to pull itself together and rise from the ground, whereupon the other two placed themselves on either side of it and the three flew away together, while I was left panting behind. In this case it was evidently the other two members of the family who returned to their wounded relative. I cannot say whether the positions taken up by the rescuers were intentional, but I had a very good view of the whole affair and it certainly was clear to me that they were giving all their sympathy to the bird in distress, and in so doing took up the formation most suited to give as active support and assistance as was possible.

ON THE SUPPOSED OCCURRENCE OF *SALIX ALBA*, LINN. IN THE NORTH-WEST HIMALAYA.

Two plants appear to have been mistaken for *Salix alba*, Linn. in N.-W. India. Firstly *S. acmophylla*, Boiss. as understood by Hooker in the Flora of British India and secondly *S. sericocarpa*, Anders.

In considering *S. acmophylla*, Boiss. it will be necessary to refer to two plants described by Andersson as *S. dealbata* and *S. glaucophylla* and subsequently reduced by him in D. C. Prodr. XVI, 2, p. 195 to *S. acmophylla*, Boiss. The object of this note is to show that as far as is known *S. alba*, Linn. is not found, either wild or cultivated in N.-W. India. I am not at present satisfied that all the willows referred to *S. acmophylla*, Boiss. have been justly reduced to one species and I think this question deserves further investigation.

Jacquemont in his Journal Vol. II, p. 7, refers to a willow he collected on the 11th April 1831, as follows :—

Une espèce de Saule, la première que je vois dans l'Inde, est commune sur les grèves du torrent, c'est un arbre qui ressemble beaucoup, par son port, au *Salix alba* d'Europe. This willow was collected at Mohan when Jacquemont was on his way from Saharanpur to Dehra Dun. It was described as *S. dealbata* by Andersson in Acta. Holm. Vol. 1850 (1851), p. 472.

Anderson l. c., p. 474, describes *S. glaucophylla* but gives no locality for it beyond "Ex India orientale reportavit *Jacquemont*." It seems probable that this willow is the one referred to by Jacquemont in his Journal Vol. II, p. 58, as "*Salix* un bel arbre voisin de *l'alba*." If so the type came from the valley of a tributary of the Ganges at an elevation of about 5,000 feet. This supposition is strengthened by a specimen of *S. glaucophylla* in Herb. Dehra which came from the Ganges valley.

One or other of these forms is probably the plant referred to as *S. alba* by Kanjilal in his Forest Flora, Ed. 2, p. 388, as cultivated in Jaunsar and Tehri-Garhwal though the description is apparently a combination of *S. alba*, Linn. and *S. sericocarpa*, Anders. It is perhaps also the plant referred to by Collett under *S. alba*, Linn. as "often planted along water-courses" (Fl. Siml.,

p. 479). Collett however describes *S. sericocarpa*, Anders. and the only specimen of his I have seen in Herb. Kew is a very poor one but seems to be *S. daphnoides*, Villars, flowering abnormally late. Specimens of willow which normally flower before the leaves can occasionally be found and they are I believe due to branches being buried under snow and not being released until the leaves on the rest of the plant are well developed. In such cases the released branch breaks out into flower and leaf almost simultaneously. In the field such abnormalities are easily recognised but they are likely to cause confusion in the herbarium.

Thomson in Travels in West Himalaya and Tibet, p. 180, refers to *S. alba*, Linn. and there is a sheet of his in Herb. Kew labelled "*Salix alba* Linn. ? Var. *ericocarpa* Kashmir, 6,000 feet." This is the *Salix alba* of Brandis, For. Fl., p. 466.

Thomson's sheet became the type of *S. sericocarpa*, Anders. in Journ. Linn. Soc. IV (1860), p. 43. *Salix sericocarpa*, Anders. is however a composite species, the male being *S. fragilis*, Linn. and the female *S. oxycarpa*, Anders. When in Pangi, Chamba State, in 1920, I made a similar match but fortunately I stayed several days in a place where *S. fragilis*, Linn., was commonly cultivated and *S. oxycarpa*, Anders., the commonest indigenous willow. A collector touring rapidly as Thomson did finding the male flowers of *S. fragilis*, Linn. and looking about for the female would be almost sure to hit upon *S. oxycarpa*, Anders. Having got the flowers as he supposed complete he might easily overlook the male flowers of *S. oxycarpa*, Anders. and thus fail to detece the error.

Hooker in the Fl. Brit. Ind. V., p. 629, correctly describes *S. alba*, Linn., but apparently quotes from Brandis For. Fl., p. 466, who in his turn quotes from Thomson West Himalaya and Tibet, p. 180, when he states that the tree is cultivated in the N.-W. Himalaya and Western Tibet.

As there are no specimens of *S. alba*, Linn., from the N.-W. Himalaya in Herb. Dehra or Kew it is probable that this tree is not in cultivation. It is certainly not as common as Collett and Kanjilal would lead one to suppose.

R. N. PARKER,
Systematic Botanist.

BURMA FOREST SCHOOL.

Prize Day.

The annual prize distribution took place at the Burma Forest School, Pyinmana, at 7-30 A.M., on Tuesday, May 2nd. Owing to the unavoidable absence of Mr. F. A. Leete, Chief Conservator of Forests, the distribution was presided over by Mr. C. B. Smales, Conservator of Forests, Northern Circle with whom the following officers took their seats on the dais: Mr. W. Mayes, Conservator of Forests, Central Circle ; Mr. J. J. Rorie, Conservator of Forests, Chindwin Circle ; Mr. D. P. Hewett, Senior Instructor, Burma Forest School ; Mr. G. S. Shirley, Deputy Conservator of Forests, Pyinmana Division and Mr. C. H. Philipp, Deputy Conservator of Forests, the Director of the Burma Forest School.

The proceedings were opened by the Director Mr. C. H. Philipp with the following address :—

Mr. Smales, Ladies and Gentlemen and Students,—To-day is the ninth prize day since the establishment of the Forest School at Pyinmana and the twenty-first since the School first opened at Tharrawaddy.

Of the 13 students in the English Class all have obtained certificates and one has gained honours. These students become Forest Rangers, VI grade, from the date of their departure from the School.

Of the 19 students in the Vernacular Class all have obtained certificates and six have gained the certificate with honours.

One honour in the Upper Class is below the average but six in the Vernacular Class is distinctly good and the class is to be congratulated.

Last year 2 students in the English Class and 5 in the Vernacular obtained honours : the total therefore for the 2 years is the same.

I should like to take this opportunity of thanking the examiners for the patient manner in which they conducted the oral examinations.

Both classes to-day complete their two years' training, the greater part of which has been undergone in the forests. Every effort has been made to make the instruction as practical as possible and I hope that the outgoing students will prove themselves good practical men in the Divisions to which they may be posted.

The detailed report on the year's work has been laid before the Board of Control, that however is principally concerned with technical details and has little general interest and I propose now to comment on our doings in other directions. Knowledge of and ability to deal with cases of illness or injury are of great importance to Forest Officers who frequently, owing to the remote places in which they work, have to deal with such and the students are given the opportunity of acquiring the necessary knowledge. 30 senior students were given the usual course in First Aid and Bandaging ; 25 of whom succeeded in obtaining the certificate of the St. John Ambulance Association, there being 5 failures.

Sports and games, as usual, occupied a good deal of the students' attention during the terms spent in Pyinmana. The athletic sports were held on the 1st October 1921. The entries were very good, as indeed they usually are, and the number necessitated the running off of heats on the previous day. The times recorded were, on the average, distinctly better than those of last year. The so-called Marathon Race was contested on 3rd October over a course of 10 miles. 41 started and 20 completed the course : 9 of the latter finished within the allotted time limit of 1½ hours. We had a strong foot ball team this year but unfortunately, owing to the dearth of big boys in the local schools, we were unable to arrange the usual number of outside matches and the team had few chances of proving its strength. Only 4 outside matches were played with the result of 1 win, 1 draw and 2 losses.

To counterbalance the loss of outside matches an excellent innovation was introduced by Mr. Lindsay Smith, to whom indeed we are greatly indebted for the time he devotes to the students' sports and games—under which teams of six a side were

formed amongst the student themselves and a tournament was held in which no fewer than 9 teams competed. Thus many students were encouraged to play football regularly who otherwise would probably have played little or not at all. I hope that this scheme of students' teams and matches will be continued in the future.

The tennis courts were as popular as ever and a successful tournament with many entries was held in September last. The students are drilled and exercised 3 times a week during the lecture terms and Mr. Lindsay Smith continued his gymnastic classes.

The physical side of the students' training is therefore not neglected. The recreation ground and tennis courts—as I hope you will judge for yourselves this afternoon—are now in excellent condition and all that we now require is a gymnasium, a swimming bath and an additional tennis court.

The extensions to the school, to enable us to accommodate 100 students instead of 75, are, as you will be able to see, now finished. These include extensions to the main building and additional quarters for the staff and students. Starting next month with the new School year we shall therefore be in a position to deal with the enlarged classes.

After this address had been rendered into Burmese by Maung Kyaw, A.T.M., the certificates, medals and prizes were distributed by Mr. C B. Smales. The following list shows the students in order of merit on passing out of the school :—

UPPER (ENGLISH) CLASS.

Higher Certificate with Honours—

1. Maung Ohn Pe, Stipendiary Student, Zigon Division.

Higher Certificate—

2. Nai Daukmai ... Siam.
3. Nai Somboon ... Siam.
4. Mg. Aung Tun, Stipendiary Student, N. Toungoo Division.
5. „ Ba Shin, Stipendiary Student, Prome Division.
6. Maung Thein I, Stipendiary Student, Zigon Division.

7. Mg. Lu Gale, Stipendiary Student, Henzada Division.
8. „ Ba Thaw, D. R. II gr., Henzada Division.
9. „ Pu I, Stipendiary Student, Yaw Division.
10. „ Pu II, Stipendiary Student, Pyinmana Division.
11. „ Ba Maung, D. R. II gr., Mu Division.
12. Mr. R. Nicholas, Stipendiary Student, Ataran Division.
13. Mg. Aung Zan U, D. R. III gr., Arakan Division.

LOWER (VERNACULAR) CLASS.

Lower Certificate with Honours—

1. Mg. Po Sin, D. R. III gr., North Pegu Division.
2. „ Sein U, D. R. II gr., Zigon Division.
3. „ Ba E., D. R. III gr., North Toungoo Division.
4. „ Paw Hla, D. R. III gr., Tharrawaddy Division.
5. „ Bah, H. F. I gr., Thaungyin Division.
6. „ Saw Nan, H. F. I gr., Prome Division.

Lower Certificate—

7. Mg. Thein II, D. R. III gr., Henzada Division.
8. „ Po Thwin, H. F. I gr., Ataran Division.
9. „ Hala Maw, H. F. I gr., Prome Division.
10. „ Po San, D. R. III gr., Upper Chindwin Division.
11. „ Zaw Hla, D. R. II gr., Myitkyina Division.
12. Shein N'tang, D. R. I gr., Yaw Division.
13. Mg. Aung Shwe, H. F. I grade, Tharrawaddy Division.
14. „ San Mya, D. R. III gr., Bhamo Division.
15. „ Sabber, H. F. I grade, Tharrawaddy Division.
16. „ Po Sa, D. R. III grade, Mongmeit Division.
17. „ Tin, D. R. II gr., Mu Division.
18. „ Po Aung, D. R. III gr., South Toungoo Division.
19. „ Ko Maung, Chaungok, Prome Division.

MEDALS AND PRIZES.

Four silver medals presented by Government.

Upper Class—

1. The best second year student in Forestry ... ... Maun Aung Tun.

2. The best second year student in Forest Engineering and Surveying	Mg. Ohn Pe.
Lower (Vernacular) Class—	
1. The best second year student in Forestry	Mg. Po Sin.
2. The best second year student in Forest Engineering and Surveying	Mg. Sein U.
The U Po Hnit Gold Medal for the best student in the Upper Class...	Not awarded.
The Old Students' Gold Medal for the student in the Vernacular Class most likely to make a good forest officer	Mg. Ba E.
The J. E. Du Bern Gold Medal for the best athlete	Mg. Pu H
The Indian Forester Prize for the best practical forester in both Classes (divided)	Mg. Bah. Mg. Zaw Hla.
General knowledge paper prizes presented by Messrs. Philipp and Hewett ...	Mg. Ohn Pe. Mg. Pu I.

Mr. Smales then made the following speech :—

I regret that Mr. Leete's health forbids his being here. Being in the Division at the inception of the School he has always taken a special interest in it and he would have liked to be here in person. However he is going home to get fresh energy and better health and I trust he will be here next year himself. But for that matter I am—and the whole Department is—interested in the School and its results—in fact everybody—the whole Burmese people, is equally interested. For it is upon the foundations laid here that so much of the structure of the future is to depend and it is of the greatest importance that those foundations should be well and truly laid.

Consider for a moment, you senior students who are now to go out and begin your careers of usefulness. What are you

expected to do? Why is it worth while equipping you as the Director and his staff have so ably striven to equip you—with all this armoury of facts and theories which the ordinary man has small knowledge of? It is precisely because of that—because the ordinary man is at present only concerned—too much concerned—with the small inconveniences the activities of the Forest Department cause to the individual, whilst he has never been made to see how in reality these activities are concerned with his larger needs—or rather his needs as a community.

And that is where you all have a great opportunity before you. You have not been trained for a mere executive drudge, carrying out blindly the behests of a superior officer. You will be expected to know why these behests are made—to explain them to your subordinates and above all to explain them to the general public whenever you get the chance.

That is the great opportunity a present day Forest Officer has to his hand. The increasing public interest in State Management will include increased interest in Forest Management. I think that you educated Rangers can do a great deal to encourage that interest, an interest which is all to the good and to be welcomed. But the more instructed—the more intelligent the interest the better for everybody. Your part is to help in spreading that instruction. You will hear some villager kick at some restriction or prohibition which causes him some personal—purely personal—inconvenience. You know why this restriction was necessary. You have been shown the long sighted reasons for curbing individual desires in the interest of the whole community. You have been shown how the labours of the Department are solely and incessantly directed towards the amelioration of the lot of the poor man. Well—go out and tell the people what you know. It is not always easy for the ordinary man to think as we foresters do in terms of peoples and of centuries. He may indeed think you at first a dangerous idealist and a prophet without honour in his own country, but I believe he can be brought to see and to understand. And when he does understand then how much will he honour the prophet who caused him to understand

and who meanwhile protected him from himself. Though the Forest Officer does not require honour: the forests themselves are his monument.

And I am not suggesting that the ordinary man is to blame in his attitude or that you should adopt a tone of superiority. Heaven knows it has taken the thinking part of the world long enough to grasp the facts of the need for conservation which is only the beginning of Forestry. How can one expect the man in the village, which in Burma is the equivalent of the man in the street, to be sufficiently acquainted with the history of the world and its geography, to see any further than his own nose. No nation in the world took Forestry seriously till a hundred years ago. All I suggest to you is that you should spread wherever you go and whenever you get the chance—that knowledge of the reasons for the Forest Department which has been imparted to you. Sow the seed. Some day it will come to fruition.

One word more. The principles of Forestry are fixed as the eternal hills. The details of the application of the principles are not. To a forester the details in their ever varying complexity are fascinating to a degree. But my point is that we can never expect to reach finality in detail. We are always learning and you must be very careful to refrain from thinking that you know everything or that you can ever know everything. Do not run away with the idea that you are finished foresters. You are not. There is no such thing as a finished forester. The real forester is for ever learning. He is like a little child at his mother's knee—at the knee of Dame Nature—and she is always ready to give more and more to those who seek it.

And the getting of that knowledge is largely dependent on powers of observation. We have tried to encourage that quality here—but also you must occasionally get away from the forms and account-books that lie in your office—get away from Codes and Manuals and *think*. Think what you are doing and why.

Some of you may some day progress into the higher administrative ranks—may some day reach the very top of the tree, but you will not get there unless you think. Get away from details

and think of tendencies and first causes and you will then be worthy of any position you can attain.

When this had been read in Burmese by Mg Kyaw, A.T.M., the company dispersed to inspect the museum, the collection of economic forest products and herbaria made by the students and the recently completed extensions to the School.

A "pagal" gymkhana was held in the afternoon on the School recreation ground. The events were framed for amusement rather than as a test in athletics as the serious school sports, comprising the usual field events, had been held in October last at the end of the lecture term.

A very large crowd was present on the ground and the events proved most popular and amusing, the pillow fighting on a greasy pole attracting the most attention.

All the events were arranged and carried through by Mr. C. Lindsay Smith with his usual energy and they included the following:—four-legged race, children's races, bun and lemonade race, sack scrimmage for teams of four, wheel-barrow race, pillow fighting, obstacle race, tug-of-war for the wives of seniors *versus* the wives of juniors.

Mrs. C. Lindsay Smith dispensed tea and other stimulants to the thirsty guests and brought a most successful afternoon to a close by distributing the prizes.

The same evening Mr. Philipp entertained the station to dinner after which the company adjourned to the School grounds to see an *anyein pwe* given by a troupe from Mandalay.

A TIGER YARN.

During the course of a tour last rains I found myself encamped one day close to a forest village which lay just outside the boundary of the Reserve. In the night I awoke suddenly thinking that I heard some disturbance in the jungle near by, but the sounds were so vague that I thought no more about them and went to sleep again. When passing through the village the next morning, however, the headman showed me the tracks of a sambar evidently in a great hurry and also the tracks of a tiger right down the middle of the village street and told me what I should have thought quite a good story if I had not had evidence of its truth on the ground before me. He said that a little before dawn he heard the sound of galloping and looking out saw what he thought was a pony in full flight passing his house. He walked down his ladder to investigate when another form came out of the darkness and passed him at a steady canter grunting and panting heavily. He had no doubt as to the identity of this second visitor and retreated hastily upstairs into his house.

At dawn the villagers discussed the events of the night and half a dozen of them went off following the tracks in the hope of stealing the prize from the tiger should he have been successful. This was the position as I found it and I sent a man after them to tell them not to disturb the kill if they found it as I would sit up over it.

When I came back from my work about 11 o'clock what was my horror to find the houses decorated with festoons of meat and *the villagers looking very pleased with themselves. The sambar* after leaving the village had doubled round in a semi-circle and had been killed within two hundred yards of my camp. I cursed the villagers heartily for being no sportsmen and told them that through their greed they had undoubtedly lost the reward for the tiger which I should of course have been in a position to give them that same evening! So abashed were they at my outburst that they offered to reconstruct the sambar at the place where he had fallen and they felt sure the tiger would return if only to

see their handiwork. This suggestion seemed at first too ridiculous, but I finally thought I might as well try it, so off they went with the head, legs and skin and I went to breakfast.

About three o'clock I went off to the scene of action to begin sitting up and there a most ludicrous spectacle met my gaze. The sambar looked like a pantomime donkey that had fallen over. The skin had been filled with twigs and leaves, the head was at a rakish angle and the legs had a detached air.

How the tiger would laugh, I thought, or perhaps he wouldn't laugh. I took my place in the machan with much chuckling, my mirth being intensified by the sight of a row of vultures sitting solemnly on a large cotton tree waiting for the meal that was imaginary.

As the afternoon waned and the mosquitoes came out I began to get bored and to think that the whole thing was ridiculous and a waste of time. Just before dusk a barking dear barked rather nervously and my friend the local shikari who was sitting up with me gave me a meaning look. I smiled at him pityingly. Three minutes later I was gazing idly at the stolid vultures when something away down on my left caught my eye. I looked and saw a large tiger walking firmly and steadily across an open space straight towards the faked sambar. I was paralysed with surprise and must make the feeble excuse that it was the first tiger I had seen walking up to a kill. The gun lay uncocked at my side, muzzle pointing the wrong way. I took it up slowly with trembling fingers and began slewing it round, at the same time trying to push up the safety catch without noise. Alas my intentness of mind communicated itself to my fingers and while the gun was still pointing in the air with the tiger about ten yards away, it went off, so of course did the tiger. My friend the shikari gave me a look which meant more than words and we climbed sorrowfully down and returned to camp.

"PYITLOMAYA."

THE NILGIRI HILLS.

"Many a green isle needs must be,"
  Erstwhile the poet said,
"In the deep, wide sea of misery"—
  To such an one was led
His lonely bark, so even I
Have happed upon a sanctuary.

Where the Blue Mountains pierce the dome
  Of the ever-changing sky,
Where the cloud-shadows errant roam
  And magic vapours lie,
My wandering foot-steps came to rest
In an elysium of the blest.

A land of ever-shifting tones,
  With wizard colours dight,
Where every stream its goblin owns
  And every tree its sprite,
Where rolling down and wooded dell
Forgetfulness and peace compel.

Such as Ulysses, wandering far
  O'er the estranging main,
Saw, and, his ship once o'er the bar,
  Could hardly leave again—
A fairy land for idle dreams
Which change what is for that which seems.

Or, haply, in far other moods,
  This placid land reveals
A menace in her solitudes,
  A terror while she heals,
Where savage crag and jagged peak
Of vague alarms and warnings speak.

Perched like a god above the world,
The fertile plain below
Lies, like a monstrous map unfurled,
For me to con and know;
But the jealous mountains whisper this:
"Now is your one short hour of bliss."

To leave this fragrant land of ease,
These hills beyond compare,
These gardens and the grassy leas,
'Tis more than I can bear;
That other life of toil and strain,
I cannot take it up again.

But hark! a thousand voices call,
I cannot linger more,
And, ere the evening shadows fall,
I seek another shore—
That other life is calling clear;
My bark! for open waters steer.

D. P. H.

RETIREMENT OF OFFICERS AT THE ROYAL BOTANIC GARDENS, KEW.

The year 1922 will be memorable in the annals of the Royal Botanic Gardens, Kew. Sir David Prain, K.C.M.G., F.R.S., Director of the Gardens and Dr. Otta Stapf, F.R.S., Curator of the Herbarium, who have held their positions for 16 and 20 years respectively, both retired at the end of February.

Their successors are two comparatively young and able men Dr. Hill, M.A., F.R.S., Assistant Director for a number of years past and Mr. Cotton, pathological assistant under the Board of Agriculture.

During July of last year Kew lost the services of that experienced and skilful botanical artist Miss Matilda Smith, A.L.S., who retired from her position after 43 years of successful work in the herbarium.

As a consequence of the above-mentioned retirements the Kew Herbarium staff arranged a dinner at the Castle Restaurant, Richmond, on the 25th February last, at which the guests of honour included Sir David Prain, Dr. Otta Stapf and Miss Smith and also Mr N. E. Brown who had some years back relinquished his duties as Herbarium Assistant. About 50 ladies and gentlemen sat down to an exceedingly well arranged and excellent repast which was presided over by Mr. H. N. Ridley, M.A., C.I.E., F.R.S., for many years Director of Gardens and Forests, Straits Settlements, now residing at Kew.

Mr. Ridley proposed the toast of the honoured guests in felicitous terms He remarked that their quiet unobtrusive work had not received the advertisement of the Press but like all the best work in the Empire it is of the greater value for all that. Sir David Prain, he added, had greatly maintained the tradition and glories of Kew during a period of exceptional difficulty and strain and one must wish him long and restful and happy years in retirement.

In alluding to Dr. Stapf he pointed out that his work on the difficult groups of grasses is of the utmost value and his account of the flora of Mount Kimabala was so graphic and accurate that it was difficult to believe he had not himself climbed to the summit. Miss Smith, Mr. Ridley went on to say, was laying down her brush and pencil with which for so many years at Kew she had built up for herself a superb monument in her splendid paintings of the treasures there. Her drawings in the Botanic Magazine are worthy to be ranked with the most celebrated artists of bygone years.

Of Mr. N. E. Brown Mr. Ridley said that long before he (Mr. Ridley) knew anything about the difference between a Mesembryanthemum and a Cactus Mr. Brown was a well-known botanist. He will be always known to science for his patient and steady work on the above-named plants and the Aroids which are such difficult groups to study.

Sir David Prain in responding to this toast on behalf of the guests took the opportunity of alluding very sympathetically to

the death last summer of Mr. Rolf, Herbarium Assistant and well-known Orchidologist.

Mr. Burt Davis, F.L.S., of Vereeniging, Transvaal, and formerly botanist to the South African Department of Agriculture at Pretoria, proposed the toast of Kew to which Dr. Hill replied befittingly and Dr. Stapf closed the proceedings by proposing the health of Mr. Cotton, his successor in office, which was cordially drunk.

The evening entertainment it may be mentioned was enlivened by some pretty orchestral music.

Still another retirement of an old Kew official is in view this year and that is of Mr. Watson who has been Curator of the Gardens for a period of over 40 years, and he will be leaving at the end of May. He will probably be succeeded by Mr. Bean, Assistant Curator and author of that valuable work to all English Arboriculturists "Trees and Shrubs hardy in the British Isles."

Kew it will be seen has opened up quite a new chapter in its history this year.

G. M. R.

REVIEWS AND EXTRACTS.

THE FORESTS OF INDIA, BY E. P. STEBBING.

In this first volume Mr. Stebbing traces the history of the development of scientific forestry in India from its conception in the early forties of the last century through the various troubles of infancy on to its adolescence, the volume closing with the events of the year 1864.

The opening chapters dealing with the geographical and climatic features of British India are followed by a short historical sketch of the history of India previous to the time when the new conditions consequent on the British occupation entailed the introduction of forest conservation. These chapters are to be recommended to any of our legislators who may feel inclined to court popularity by slackening the protective powers of the Forest Department. Any one who thinks that a herd of goats to-day is worth half a lakh of rupees twenty years hence should ponder over these pages and perpend.

Chapter IV on the character and distribution of the forests is the least satisfactory portion of the volume. The writer has dealt with the subject by taking what are practically zones of atmospheric precipitation. This method of treatment which is successful when the subject is as large as Schimper's Plant Geography, does not give a true idea of the various types of forest vegetation when applied to a group of relatively small areas as in the present case. It would have been better we think to have adhered to the regional description adopted by Gamble

and again by Troup in his recent work. This method of treatment gives a clearer idea of the vegetation thar that adopted in the present work.

From Chapter V onwards the subject-matter should have the greatest interest for forest officers, and we could wish that all members of the legislative councils and the various secretariats could be persuaded to study it closely.

It is unfortunate that the separate beginnings of the service in the various provinces have compelled the writer to deal with them according to their separate areas, thus interrupting the sequence of development through the book, but t is clear that no other method could have been adopted without losing the chief point of the lesson to be learnt from this history. No one can fail to be interested to see how each province in turn has eventually been forced by circumstances, usually much against the will of many of the powers that then were, to adopt a policy of conservation of forest resources. To this passive and occasionally active opposition we must ascribe the almost apostolic fervour which animated the earliest members of the service.

The first appointment of a Conservator of Forests was made in the year 1807 but his duties seem to have lain more in the direction of getting timber cheap for Government dockyards at the expense of the traders than of looking after the growing stock.

Actually the honour of first instituting forest conservation, as it is now understood, belongs to the State of Travancore, which in 1837 possessed an officer whose sylvicultural notes on teak are the first of which there is any record. It would be interesting to find out who was actually responsible for the appointment of this officer and it would be a grateful tribute to his memory if some of the present officers in Travancore could bring to light any further records of his activities.

It is the year 1840 which really marks the beginnings of the Service, for in that year Mr. Conolly began his efforts which finally resulted in the Madras Government adopting a policy of protection for some of the surviving forests of the province, and providing funds for the start of the famous Nilambur teak plantation.

On reading the various extracts of official correspondence of the years intervening between this date and the year 1856, when Mr. Brandis was appointed Superintendent of Forests in Pegu, the most striking feature is the apparent simple trust in the altruism of the timber traders. It is hard to believe that a corporation of traders, who had not been conspicuous for their works of material improvement to the country, could imagine that other traders would be more careful than they themselves in looking after the future of their source of wealth. One cannot help thinking that the arguments brought forward, that traders and private forest owners could be trusted to see that the forests were regenerated and not devastated, were only so much verbiage consciously put forward to stave off the hour when definite action would have to be taken.

One of the most interesting chapters of the book is that which deals with Brandis' work in Burma. The magnitude of the task and the hopeless inadequacy of the means with which to tackle it must have been enough to discourage the most enthusiastic forester, and after reading the account given by Mr. Stebbing one cannot but admire the soundness of the methods he introduced and wonder at the sureness of his foresight.

From that period onwards the record deals mainly with the exploration of the lesser known forest areas and should bring vividly before the general reader the number and complexity of the problem which face the service in their endeavour to accommodate scientific forestry to the habits and customs of the various Indian peoples.

The volume fitly closes with the despatch of 1862 from the Governor-General in Council to the Secretary of State on the creation of a Forest Department and his reply, through which, at last, scientific forestry gained the recognition it deserves and by which the Indian Empire became endowed with a property worth over 220 lakhs of rupees to it annually.

The illustrations to this volume are with one exception excellent and there is a good glossary and index. From a forest officer's point of view it would be an improvement if the writer had been able to add the modern rendering of some of the place

names but we recognise that to do this would have added enormously to the labour of bringing together this mass of otherwise inaccessible information. The Forest Department owes a great debt to Mr. Stebbing for having undertaken this work.

THE DUNBAR-BRANDER TRUST FUND.

Nagpur, the 1st June 1922.

No. 321-208-XV.—Whereas the sum of Rs 749-1-4 (rupees seven hundred and forty-nine, anna one and pies four) has been collected by certain friends of Mr. A. A. Dunbar-Brander of the Indian Forest Service and has been made over to him in trust with the object that it may form the nucleus of a fund to relieve the distress of Forest Guards in the Nimar Forest Division, their wives, children and dependents;

And Whereas the said Mr. A. A. Dunbar-Brander has made an application under Section 4 of the Charitable Endowments Act, 1890 (VI of 1890), for an order vesting the property in the Treasurer of Charitable Endowments and under Section 5 of the said Act for the settlement of a scheme of administration.

Now, in pursuance and exercise of the powers conferred by Sections 4 and 5 of the said Act, it is ordered by the Local Government that the said sum of Rs. 749-1-4 be and the same is hereby vested from the date of this notification in the said Treasurer of Charitable Endowments to be held by him and his successors in office subject to the provisions of the said Act and the rules from time to time made thereunder upon trust to apply the said moneys and the income thereof to the endowment and maintenance of a permanent fund to be called the "Dunbar-Brander Trust Fund" in accordance with the provisions in that behalf contained in the scheme the particulars whereof are set forth in the schedule hereunder written, and it is hereby further notified that the said scheme shall come into operation on the vesting of the said moneys in the said Treasurer of Charitable Endowments.

The Schedule above referred to.

1. The said fund shall be called the "Dunbar-Brander Trust Fund."

2. The Conservator of Forests, Berar Circle, and the Divisional Forest Officer, Nimar Forest Division, shall *ex-officio* be the administrators of the fund.

3. The interest shall annually be paid by the Treasurer to the Divisional Forest Officer, Nimar.

4. The cost of administration, *i.e.*, postage, money-order commission, etc., shall be charged to the income accruing from the fund.

5. The net income only accruing from the fund in each year, after deduction of the cost of administration, shall be applied by the administrators in relieving the urgent needs of Forest Guards, their wives, children and dependents, in cases where the urgency has arisen out of untoward and unavoidable circumstances.

6. The administrators shall be the sole judges as to the fitness of each case and the amount to be paid in each case.

By order of the Governor in Council,

E. GORDON,

Revenue Secretary to Government,

Central Provinces,

Central Provinces Gazette of June 3rd, 1922.

THE IDEAL HOMES EXHIBITION.

Extract from a Report on Indian and Burma Government Exhibit at "Daily Mail" Ideal Homes Exhibition, held at Olympia, London, from March 1st to 25th, 1922.

The Stand space, which measured 46 feet by 25 feet, was situated in one of the very best positions in the Main Hall at Olympia, and taken by the Government of India and the Government of Burma in conjunction with Messrs. Burroughes and Watts, the well-known billiard table makers.

The exhibit consisted of a billiard-room 27 feet by 18 feet, panelled in Laurel-wood, the end space facing the main gangway of the Hall being left open. This room was completely furnished

by Messrs. Burroughes and Watts with a full size billiard table in Laurel-wood, a cabinet and marking board, cue-stand, two tables, billiard light and settee, all made of Laurel-wood. The billiard cues displayed were butted with Laurel-wood and Padauk. The billiard table was a magnificent example, being the very best description of table made by this well-known firm, the price of the same being £265. The table was immensely admired and the centre of large numbers of people from time to time. Other beautiful pieces in the room were the cabinet and marker.

Adjoining the billiard-room was a dining-room, 18 feet square, panelled in Gurjun-wood, the end facing the gangway being left open. This was furnished with a billiard-dining table of Messrs. Burroughes and Watts patent, made in Gurjun-wood with a billiard light over—also made in Gurjun-wood, side-board and bureau of Laurel, 6 very handsome ordinary chairs and 2 arm-chairs all to match made in Koko, a fancy table of Sissoo with a mosaic top composed of 22 different Indian woods, and an Indian Silver Grey-wood Mirror.

These two rooms had open doorways between and people were able to walk the whole way through a length space of 46 feet.

The remaining space of the stand, alongside which was another public gangway, was utilised to full advantage with a display of Parquetry flooring in Padauk, Laurel-wood, Silver Grey-wood, Gurjun, Rosewood, Teak, Koko, and Marble-wood. These were made up into choice designs and laid out on the floor, the width of this range being about 4 feet. Behind this, and against the wall of the two rooms, was a range of furniture consisting of a piano in Laurel-wood and Walnut burr, by Broadwood White & Co., who kindly loaned it for the Exhibition; a side-board in Laurel-wood being a replica of the one presented by the Government of India to H. R. H. the Prince of Wales; a Laurel-wood and Walnut burr dressing table and bedside table; a commode and writing desk in Sissoo, with Indian Prima Vera curls and Marble-wood inlay; a figured Andamans Padauk writing desk, kindly lent by Sir George Hart; and a set of garden furniture, a table and four chairs—all made to fit together, in Gurjun-wood.

There were also exhibited on the wall cabinet making and joinery panels of Laurel-wood, plain, figured, and curl; Andaman Padauk, plain, figured and curl; Burma Padauk; Silver Grey-wood; Gurjun; Thitka; Coral; Prima Vera; Pyinma; Haldu; White Bombwe; White Mahogany; Rosewood; and figured Teak, together with a number of photographs showing various works which have been already executed in Indian and Burmese woods. Among these one of the most prominent was the beautiful rooms which have been executed for the General Electric Co.'s new premises at Birmingham in Indian Silver Grey-wood, and in which both in design and material the effect is truly remarkable.

The Exhibition was opened on the 1st March by the Princess Alice, and was then open to the public, Sundays excepted, from 10 A.M. to 10 P.M. until the 25th March, inclusive. During that period over 3,50,000 people visited the Exhibition, and the attendants on our stand had a very busy time dealing with the enquiries from all classes of people; upwards of 500 enquiries were actually received. A very keen interest was shown in the new woods, not only by Architects, Engineers, Contractors, and practical business men, but also to a very large extent by the general public, who sought all information. The folder which was issued for the Exhibition gave some information regarding some of these new Indian timbers, this was much in demand and seemed to be greatly appreciated by all enquirers. It was impossible to take a record of every enquiry, but where it was possible these were obtained.

Subsequently the list was analysed, the result showing that *enquiries had been obtained as follows:—*

From	Architects	43
„	Builders, Contractors and Joiners ...	53
„	Cabinet Makers and Pianoforte Makers ...	55
„	Engineers and Surveyors	7
„	Timber Merchants	12
„	Flooring Contractors	3
„	Motor-car and Coach-builders	4
„	Ship-builders	2

From Miscellaneous manufacturers	...		...	15
" Private people	...	...	...	110
Enquiries for :—				
Timber and Veneers		...	...	206
Floorings	...	...	...	45
Panelling	...	...	...	25
Furniture	...	...	...	33

We may say without any hesitation that the general impression upon the visitors was one of great surprise at the extraordinary beauty and utility of these previously unknown woods.

On the whole it seemed that the most popular in general esteem was Padauk, Laurel-wood, Grey-wood and Gurjun.

The organisers of the Exhibition—the "Daily Mail" people themselves; Messrs. Burroughes and Watts, who were more or less associated with us; and a great many other persons of importance, congratulated us upon our exhibit, which has been characterised by many people as a feature of this very large Exhibition.

A SKETCH ON SWEDISH FORESTRY FROM AN AMERICAN STANDPOINT.

BY H. R. WICKENDEN.

Forestry practice in Sweden is in many respects of interest to us Americans because it is yet in a plastic form and is applied to forests which are not as well ordered and controlled as in Germany or even better, in Denmark; at the same time it is very broad-minded, not so fixed and predetermined as in some lands where forestry started centuries ago. While some regulations and laws have been existent for a much longer time, the most decisive steps were first taken in the fifties of the last century and these have undergone many revisions since then, until to-day a fairly permanent system is in force.

It is unnecessary to comment on the climate and forest types as this information may be known or available to those interested. The following generalisation suffices here: Scotch pine and Norway spruce are the chief commercial trees, the development of which has its greatest importance in the middle of Sweden,

especially in the latitude one or two degrees north and south of Stockholm, including the finely wooded provinces of Varmland and Dalarme. The forests are almost invariably of very simple composition. It is seldom that more than three species—pine, spruce and birch—occur together, but to a great extent pine or spruce occur also separately. The freedom of the forests from brush and prolific growths is striking, and simplifies also the work of the forester; even regions which have not undergone special care have a park-like appearance. Taking a common figure for both of the chief species, one might state that they reach a 10—12 inch d.b.h. 90 feet in height with a form quotient of ·70 for pine and ·65 for spruce at an age of 120 years. The coniferous forests are not encumbered with underbrush, but moss (most frequently hylocomium), whortleberry, crowberry and blueberry shrubs cover the ground, much given in the north to the formation of raw humus. Birch occurs everywhere, its ground-improving quality being in evidence just as in America; it also follows in the wake of fires together with aspen. The forest fire danger, by the way, can be looked upon as a past thing now; the amount of burn each year being quite negligible from our view-point at any rate.

As regards other very important timber districts the whole of the north, called Norrland, is fairly well forested. Here, at the present, exists an over-supply of old forests and too little young growth. A little absolutely virgin forest is yet in existence but most of the forests are disordered remains after the unsuccessful diameter limit cuttings—the only system practicable when woods had less value than now, and no consideration given to the welfare of the forest. While the wood, especially the pine, is of very good quality in the north, it takes 15 to 50 years longer to reach the same dimensions as in the south.

All the above-mentioned coniferous forests are found in regions both undulating and very mountainous, which abound with driveable waterways, but the country is also infested with bogs and muskegs (of the sphagnum types), taking up 8 per cent. of the area in the southern, and reaching 30 or 40 per cent. in the northern regions.

The flat country of the southern extremity is mostly covered with hardwoods: beech, spruce, etc., on the small areas not taken up for agriculture.

The trained foresters are of three *grades*, namely, the Jagmastare, the Forstmastare, and the Skogvaktare or Kronojagare. The Jagmastare's course consists of a preparatory field practice course of ten months, then two and a half years at the Royal Institute of Forestry in Stockholm, where the curriculum is about as follows:—

	Per cent.	Per cent.
Botanical Subjects	15·0	(F 5·0)
Geology and Soils	8·5	(F 2·5)
Zoology Subjects	8·0	(F 3·5)
Game and Hunting	3·5	
Law	8·0	
Chemistry	2·0	
Forest Economics and Statistics ...	5·0	
Book-keeping	6·0	
Agriculture	3·5	(F 4·0)
Technology and Utilisation ...	14·0	(F 25·0)
Mensuration	16·0	(F 30·0)
Silviculture	9·0	(F 30·0)
Mapping	1·5	

(The first figure is the percentage of total lecture hours, and the practical work, if any, is given in the two field summer courses of two and one-half months each. The time percentage for the summer course is indicated here by putting "F" before it.)

The Forstmastare, who cannot enter the State Forestry Service, gets only about three-fifths as much theory but is required to have at least two years' apprenticeship. The average have five years, owing to the great competition in getting admittance.

The Skogvaktare course corresponds to our ranger courses, being mostly field work, arithmetic, elementary mathematics book-keeping, mensuration, silviculture, etc., and lasting about one year.

Entrance requirements are: for the Jagmastare, university entrance requirements; for the Forstmastare, about what corresponds to three years of our high schools. The Rangers or Skogmastare need only grammar school training but a lot of practice. All the students are chosen competitively; about thirty-three Jagmastare, and ten Forstmastare (in this latter course only about one-fifth of the applicants gain admittance), being admitted to the Royal Institute of Forestry each year.

The handling of woodlands is not unrestricted even on private property. There are regulations which compel the application of rational forestry everywhere and differ for different regions.

The law of 1903 stated generally "that the cutting of woodlands is not to be carried on in any way detrimental to reforestation," and provides for the establishing of "Provincial Boards of Woods and Forests." These boards employ a staff of trained foresters to enforce the forest law, to spread the knowledge of silviculture among the people, to give expert advice on and oversee the handling of private woods; all for very low charges and in many cases free. They also handle certain funds for reforestation purposes and carry on some of this work themselves.

Failure on the part of any owner to reforest ground in a given time after final cuttings may cause the local board to interfere and possibly plant the area at the owner's expense. The result of establishing "Provincial Boards of Woods and Forests" is very satisfactory, for useful information on silviculture and handling of woodland has been spread in every part of the land. In this way forest capital tends to increase.

The cost of keeping the organisation and its staff is met by the levying of a small "forestry fee" on wood products; about 6 cents per thousand feet of lumber, and 13 cents and 8 cents per ton, respectively, for chemical and mechanical dry pulp; half this amount for wet pulp.

In 1918 further progress was made by passing a provisory law which has been permanently adopted since then. This new law states that "no cutting shall be carried on in a way not in accordance with the practice of good forestry." The meaning

of "good forestry" has proved clear enough to prevent vandalism. This statement, although general and almost vague, not only compels reforestation, but also prevents the butchering of thriving young woods. The law promises to be effective not solely because of its wording, but more because it is intelligently enforced. The principles of forestry aim first at permanently increasing the revenue from the forests. This can only be done by protecting all fast-growing wood and keeping every suitable area under forests.

The 1903 law produced good results but it did not go far enough; in many cases the wood was cut without consideration for the regrowth, the land denuded, being declared "old pasture land" or "swamps," not affected by the law. The wasting of young wood when prices were high could not be prevented; it was merely necessary to reforest the land in some manner after cutting, in order to comply with the law.

It is evident that since any doubtful mode of cutting is liable to be stopped, individuals find it safer to seek the approval of the board, that is, to obtain the free advice of technical men before any cutting is undertaken. Obviously this is done more often from mercenary reasons, to make sure the lumbering operations will not be stopped. Regardless of the true reasons causing requests for technical advice, the result is beneficial.

The Central Experiment Station at Stockholm is divided into a Forest Department, a Natural Science Department, an Entomological Department, and a Department for Reforestation Trials in Norrland.

The Forest Department concerns itself with all silviculture, mensuration and regulation problems. At present regeneration and the development of stands under different treatments hold the general attention. About 1,200 sample areas are distributed over the whole land. Moreover, this department has many establishments for the cleaning and gathering of seed, which is furnished to any forest nursery at cost price.

The Natural Science Department handles all botanical, chemical, and meteorological questions connected with the work

of the station. Investigations on diseases and damages occurring in the forests on type and species and on soils are also carried on.

The Entomological Department is concerned with the matter of bark and wood borers, insects which destroy cones, and insect troubles in the nursery.

The Department of Reforestation in Norrland is a result of dire necessity in that respect in northern Sweden, and for the present it has on its programme questions of local seed production and germination.

It is worth noting that while there are forest regulations affecting private ownership, these do not affect greatly the companies proper who keep far within the bounds of the law, seeming to vie with each other in developing better systems and handling their woodlands for what is considered the ultimate best.

The forester does not have to advertise to let people know he is a useful individual ; they know it. A lumber industry is not only one which cuts and sells timber, but produces it.

The Chief Forester (in the Government service, "Over Jagmastare") has under him "Revir Forvaltare" or division managers (generally a graduate Jagmastare or Forstmastare). These divisions or "Revir" in middle Sweden might contain about 75 square miles of woods for which a single working plan may apply. These divisions are further divided into districts of perhaps 13 square miles, each looked after by a ranger, and further subdivided into tracts which might be called the "working units," on which special statistics may be kept.

The ranger handles the work directly, having foremen, scalers, and markers under him. He keeps tab on wages, scaling, etc., and sends in pay lists and reports to the division's office for approval, which in turn sends in summaries to the Chief Forester's office.

The companies try as much as possible to have permanent forces of workmen who occupy dwellings and farms in different parts of the woods, being under contracts which, while giving them

certain advantages, also guarantee the company a fixed minimum number of days labour. As can be conceived from this the manager is constantly confronted with a multitude of matters concerning house repair, construction, farming, and providing the workmen's needs, as the companies own certain tracts of country outright. These managers are sometimes like little kings having power direct and indirect, social and otherwise, more than is healthy for the average mortal. While a wise manager can do a lot of good and holds a fitting position for European conditions—where the shades of feudalism have not departed so long ago—still a man unsuited to the place can cause a great deal of unpleasantness and to a "strictly neutral" observer, the causes of Bolshevism are not hard to find.

The method employed in final cutting is clear cutting with or without seed trees. The period of selection cutting with a diameter limit is passed. It had disastrous results in the north and shows plainly that this system is only practicable under favourable climatic conditions on good soil. There are, however, certain reserved areas, or regions adjoining the treeless highlands, which are cut with the greatest care and protected by special regulations to prevent, or at least delay, the lowering of the tree line. Here a selection system is carried on, but only in such a way that existing wood conditions are either improved on or not in the least manner disturbed.

Several methods, mostly German, have been attempted in the south to obtain natural reforestation; the successes seem to depend on the favourable sites.

Over Jagmastare Wallmo has introduced a system of group selection cutting, consisting in first selecting favourable open spots where seedlings are already found, enlarging the openings by cutting and thinning heavily a belt around them. The process is repeated every few years. While these trials have only gone well locally, the principles brought out in the matter of thinning and ground cover have had a good deal of influence or the present practice. Each of these efforts show that natural reforestation is possible in each case under certain conditions, but the fact always

remains that the cost of exploitation under extensive conditions takes undue proportions when one has to cut in a messy way. As mentioned above, clear cutting is now preferred, and is carried on, on areas ranging from belts 30 yards wide up to any size and irregularity of figure. Almost all companies are trying natural regeneration of course; and good results are often obtained, especially on the better kind of ground. Scotch pine, for instance, is quite easily regenerated in the south and middle Sweden, on the so-called pine heaths by leaving seed trees and working up the ground with a Finnish plow* or harrow; but also very often without this preparation, the pine's tap roots being of great importance in this case for withstanding exposure. As to the spruce, it cannot so readily be left in the open as seed trees. Its seedlings, nevertheless, may first get a start under a relatively strong overcovering, and although the majority of young plants may dry up after the stand is removed, enough seed comes in from the sides to furnish seedlings, filling in and insuring regrowth. That is, providing the cut is not too broad and wrongly exposed to the wind.

Thinnings have been carried on for a long time, but until recently they were mostly light and moderate, or so-called "low" thinnings, and have not influenced the growth as much as the newer forms of so-called crown thinnings. The general practice is to thin as soon as the wood output will pay for the trouble. In southern Sweden it might begin quite early or at any rate after thirty years, when the wood obtained can be used for making charcoal; but in the north it may be considerably later, especially if the wood can only be used as pulp wood (which might be taken to about 4 inches d. b. h.). Broadly speaking, it has been the custom to consider thinning up to 10 per cent. of the stand's volume as "weak" or "light," 10—15 per cent "medium," and 15—25 per cent. "heavy," if the thinnings are repeated every five years.

* The "Finnish plow" has a share no larger than one of the large teeth of a corn cultivator. It is mounted on a large wheel which facilitates its being lifted over stones, roots and brush heaps.

The most modern principle is to keep the stands well closed until the trees begin to drop their lower branches, then to increase the degree of the thinnings, returning every 10 years for a cut of 20—30 per cent. "from above," that is, with most attention directed toward the crown conditions. As opposed to the old practice, the "crown thinning" aim first at giving the finest trees of the dominant classes better chance to develop by giving them room and light; then also, quite unlike what one used to do, to spare harmless young suppressed trees which keep the ground covered and in good condition by hindering the growth of undesirable vegetation which might establish itself after the thinning owing to the greater intensity of light. One is more and more convinced that the severer thinnings are going to prove more advantageous. In conclusion one may say that, from a silvicultural standpoint, thinnings keep two main objects in mind: (1) to maintain or increase the growth in value; (2) to keep the ground in good condition, especially before the final cut and regeneration.

Regeneration is mostly obtained by planting or sowing in spots. To be sure, planting is a very positive way of getting a young growth started, but it is expensive. A fact not always heard of in America when referring to or praising the industrious planting in Europe is that labour has been two or three times cheaper than in America. Now that the price of labour is going up there also, one begins to look around for satisfactory regeneration, without such large expenditure. Luckily, many efforts have been quite successful. Artificial regeneration is still the sure cure but not always the cheapest method of getting a new growth, even considering that time in money and in natural reforestation, land might sometimes wait for its new growth. Sowing in spots made with a mattock or planting with 1·5 meters between the plants or spots (1,800 per acre)* are the most usual methods. The ground is left untouched for a year or two after

* Some planting in America has been affected at moderate costs by planting only half the amount of plants mentioned. In spite of the fact that this given number of plants per acre has been determined, by experience, it will be interesting to see the results of these trials in a few years.

the cut to allow the débris to rot down somewhat, and the numerous bugs to disappear or else light burning takes place after the cutting and the ground is planted or sowed. Sowing has been widely adopted heretofore on account of its apparent cheapness. But in many places one recognises now that the crowding in spot which takes place in earlier years can be quite detrimental to the growth and often, in the case of the pine, branchy dominant trees get the upper hand in the struggle for existence. One has had bitter experience in the sowing of the seed coming from tracts unlike in climate to that where the sowing was done. It was about the period of 1870 to 1880 when artificial reforestation had become popular that one looked around for cheap seed and found it in Germany. The knotty, unsightly, young stands resulting from these early forest cultures were at first mistaken as showing that artificial reforestation was impossible and "unnatural." Now that the trouble has been discovered, planting is done with Swedish seed. (German spruce is however allowed in the south.) The removal of these forests long before they have reached maturity is a serious proposition in some parts. It is principally for this reason that the Government has established seed collecting stations in each province. The type of tree already existing is the one best suited to the climatic conditions. Local variations in type is very evident in the case of the pine. The southern pine has a conic spreading crown while all the northern trees are more cylindrical in shape, having also a better stem form. This is thought to be nature's provision for protection against excessive snow accumulation on the tree crown.

Planting with the bore is done both in unprepared ground or in spots loosened with a mattock. Both German and Danish methods have been tried in the south where good soil will permit greater outlay in regeneration. One finds here large forests having an artificial origin; there are tracts where numerous 70-year-old plantations are to be found so that one can get a good idea of what results to expect in artificial reforestation. The period just passed has been partly marked by the fad of having as fine and as large artificially reforested areas as possible,

this question often taking most of a forester's attention. But it was a very fortunate "fad." It seems now that forest culture has taken its place in the routine work and receives its limited attention, but no more; it is merely part of the business, just as logging, driving, etc., and one only tries hard to get it done cheaply and well.—*Journal of Forestry, Vol. XVIII, No. 8, December 1920.*

AIR POISON SPRAY.

One of the most convincing illustrations of the value of aeroplanes in helping to combat destructive plagues of insects is now forthcoming in reports reaching this country of a series of experiments made under the direction of Mr. H. A. Goddard, State Entomologist of Ohio, U. S. A.

A grove of catalpa trees at Troy, Ohio, six acres in extent, was threatened with defoliation by caterpillars. An expert went up as passenger in an aeroplane, carrying with him 200 lb. of arsenate of lead.

This, as the aeroplane flew low over the grove, was "dusted" down in the form of a powder by means of special mechanism, so that it fell not only upon the tree-tops, but also among the foliage.

Within three days of this "dusting," done in fifty-four seconds, it was found that 99 per cent. of the caterpillars were dead, millions of them lying on the ground and the remainder hanging lifeless from trunks and branches.

So successful was this experiment that a further use of aeroplanes, with perfected apparatus for spraying "poison clouds," is to be made in saving large forest trees from the attacks of insect pests.

In France, where special attention has also been paid to this problem, it is proposed to use scout-type aeroplanes for discovering the location of grasshopper swarms, and then for scattering of poisoned bait for the destruction of these insects.—*Daily Mirror.*

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IN THE LAND OF THE MONBAS.

Beyond the confines of British India, in a wild no-man's-land of great mountains, precipitate gorges and racing rivers there lives a small and little known tribe called the Monbas. Guarded on the North by everlasting snows, and on the South by a wide belt of impenetrable and evergreen forest, not more than half a dozen Europeans have ever penetrated into their habitation, or had the opportunity of seeing them in their natural state. When therefore I was given an opportunity recently of a quasi-scientific tour through the Monba hills, I jumped at the offer.

The trip opened with a strenuous day. Starting at 7 A.M. with a light *chota hazri* inside us, we motored for 7 miles along the worst road in Asia, to the confines of the unknown, where it petered out in a little footpath cut through the forest to the foot hills by the jungle tribes. Halting for an hour or two for the transport to catch us up, we walked for hour after hour through the most impenetrable type of forest in India, the evergreen forests of Assam ; hedged in by a living wall of solid undergrowth of

ground-ferns, bamboos, and all manner of shade bearing plants, through which towered up the columnar stems of gigantic trees, their crowns usually concealed from view by the lower canopies of vegetation, but gaps afforded occasional glimpses of huge branches clothed with orchids, and ferns, and festooned with loops of immense creepers. The sandy bed of an occasional stream, revelling in the pure sunlight, gave a vivid contrast to the perpetual gloom of the great forest. A great silence engulfed and followed us as we moved along, which was only accentuated by the occasional thud of a falling elephant apple. Once only, towards sunset, the silence was interrupted for a moment by a distant crashing and crackling in the bamboos and undergrowth, evidence of the presence of a herd of wild elephants. Then, (to paraphrase a beautiful poem)—

" The sun went down, and the moon shone out,
all over that sea of growth,
But not for a moment could we stop,
although we were weary both. "

But steadily the distant roar of a mountain river grew louder, cheering us on with its note, as on its banks we were to camp that night, and presently the twinkling camp fires of the advance party came into view, and we had arrived. The curious hill dish, a stew of mutton and white-of-egg, with which we broke our long fast, tasted delicious.

The next day we paid a visit nearby to the winter encampment of some of the Monbas, many of whom leave their hills in the cold weather months to graze their sturdy little ponies and quaint little cattle on the luscious growth of the foot hills. The encampment was situated at a point where the river divided into two branches, and was backed by ridge after ridge of hills, densely covered with ever more impenetrable and glorious forest, towering up to the high pass ten thousand feet above, which we were to cross in two days' time. The encampment consisted of forty or fifty large and commodious huts, constructed of plaited reed or bamboo on stout wooden posts. As we approached, the whole population, numbering perhaps 600 to 700 in all, thronged around

us in the most friendly way. The Monbas were originally of Mongoloid origin, their religion is Buddhism of a sort, but their weird and wonderful language is entirely their own. It is an astounding fact ethnologically in these hills that quite small groups of a few villages have their own language, which is totally unintelligible to similar village groups near by, and even the roots of their commonest words have no connection or relation. The wild medley of different tribes, communities and languages along these hill tracts afford an ethnological problem that has never been tackled. The Monbas are a comparatively weak and therefore peaceful tribe, and subject to occasional loot and oppressions from their more warlike neighbours the Akas, easily recognised by their wonderful headdress of plaited grass and toucan feathers, and with trumpet shaped silver cylinders in their ear-lobes, or from the still more fearsome and utterly savage Dufflas, with their poisoned arrows and spears, and characterised by the great knob of hair on their foreheads pierced with wooden skewers.

The Monbas have no such peculiar characteristics, unless it be the dark coloured close fitting woolly skull cap, with short tassels, from under which their shock of black hair sticks out. They wear a wool cloak frequently dyed red with the wild madder, and round the waist a belt carrying a short sword or *dah* in a wooden sheath; even the smallest children habitually carry this weapon of utility. With the chiefs and headmen, the sword has an elaborate handle and sheath of plaited silver wire and these silver decorations, together with all the silver utensils drinking bowls and ornaments are beaten out of rupees! When on the march, each man carries a bow and quiverful of arrows, and when peradventure a squirrel or small animal or a flock of birds is met with, a great shikar ensues. They are not remarkably powerful or accurate bowmen however, and they usually creep up to within ten yards of their prey before risking a shot. And then they usually miss!

To return from this digression to our ceremonial visit. Beautifully worked saddle rugs were placed in the open for us

to sit on, and similar rugs for the two chiefs. For the next hour, while a fluent but mixed conversation in several languages was being carried on (in which I personally could take no part as the four languages in which I can converse—English, French, German, Urdu, were of no use in that country), we were kept refreshed by a limitless flow of a heady and intoxicating barley-beer, served out of colossal bamboo sections into little silver drinking mugs. In the intervals of beer drinking, an opportunity was afforded of studying these people at close, almost too close, quarters. Their amazing simplicity was only exceeded by their amazing state of dirt, and nearly all were afflicted with goitre. The women were not unprepossessing under their layer of dirt, and carried their papooses, red Indian fashion—tied in a shawl on their backs. One bashful maiden appeared greatly embarrassed by the importunities of an ardent lover, who in a manner not unknown amongst more civilised communities, squeezed her frequently and firmly round the waist, until she took refuge in the midst of a bevy of matrons. The children amused themselves strenuously with wrestling and the long jump, even tiny little naked tots who could scarcely toddle, were struggling valiantly to clear a foot or two. Altogether they impressed one as a simple, happy and friendly people.

When the visit was over, we returned to our camp to prepare for the strenuous days to come. On the morrow, our path led again through the encampment, and this time we were taken into the chief's house, and as we had apparently finished the supply of beer in cold storage on the previous day, it was brewed fresh before us, and given us to drink all hot and strong. The old beldame in charge of the brew added the necessary piquancy from time to time, by using the brew dish as a spitoon!

At length we gird up our loins and depart, and abruptly we are in the most wonderful tract of forest scenery that one could ever see. Palms and plantains and incredible canes and giant gingers and a lush dank vegetation, under trees whose dimensions leave one breathless and with a neckache. And everywhere orchids and rampant climbers swarm and cluster and

cling. But beyond all are the ferns, the real tree-like ferns which look like palms, and ground ferns of a thousand shapes and sizes up to occasional monsters with fronds 8 and 10 feet long, and climbing ferns and strings of ferns on the trees and branches; the earth and air and sky seem permeated with fern in a million forms. And the path is strewn with all manner of fruits and seeds, the long scarlet fruiting stalk of a Michelia, a small mango-shaped fruit with a vivid purple core and a smell of cyanogen, great acorns completely embedded in their spiky cups three inches across and a hundred others. For all the first and half the second day we crawl like ants single file through this overpowering example of virile nature unimpeded by the acts of man, rising steadily a thousand feet to the hour, and then a rest for the coolie gang. And as we rise, the air strikes cold and thin, and our unaccustomed lungs pant to the rarified oxygen, while long forgotten muscles come once more into evidence. The forest flora changes also with the increasing altitude, sombre evergreen oaks mix with leafless maples and birches, delicate little purple primroses give a touch of colour to the ground, and a variety of exquisite scarce rhododendron trees with creamy or pink or mauve or crimson flowers blaze above. And every twig and shrub and stem and tree is hung and draped with long beards of a dull coloured moss, sure indication of a mist laden climate and a heavy rainfall. And that night, camped at 9,000 feet with a feel of snow in the air, and more than a feel of frost on the ground, one welcomes dinner by the roaring camp fire, and a bed with abundance of bedding. Early the next morning the start is made, and in a short time, patches of snow are met, and then a little streamlet frozen stiff, and at last on the crest of the pass itself pure continuous and hard frozen snow. And here one gazes with incredible eyes at the abundance of marks of wild elephants! Elephants that roam for choice at 10,000 feet altitude on such tremendous slopes are beyond the ken of one's philosophy. Apart from the sheer physical difficulty for an elephant to move at all in such country, why should he want to expend a hundred million foot pounds of energy in raising his great bulk to this great height? There neve

has been, nor ever will be, a shortage of elephant fodder in the foothills, so hunger cannot drive him. Is it to avoid the heat, the stinging flies, the leeches, and all the loathsome insects that seethe out in the rains, and does the elephant, like Homo Sapiens, have hill stations for the hot and muggy seasons?

Once the pass is crossed, the forest type abruptly changes again, and we journey through a land pre-eminently of conifers, the homely English yew (*Taxus baccata*), the stately Tsuga (*Tsuga Brunoniana*), the blue pine (*P. excelsa*) of the Punjab. Mixed with these is a deciduous oak, wonderfully reminiscent of the good old oak of England, and the crimson rhododendron of English gardens, while bluish purple primulas and white begonias add their little quota to the general colour scheme. We are no longer boxed in with walls of vegetation, but vistas of valleys and ridges stretching to the great snows on the horizon open out between the trees. And thus we drop down for 4,000 feet to a lovely little stream, and down its banks for another 1,000 feet until it loses itself in a glorious trout-river, but where, alas, there are no trout. Here we find our camp (for we have dawdled on our way behind the transport) fixed up in a Monba fort in the middle of a Monba village, the permanent home of the cheery crew we left three days before, and now nearly, but not quite, deserted. A quaint and interesting village, superficially resembling and yet quite unlike any hill village that one has ever seen, with several unique and interesting features.

There was, for example, a monster prayer-wheel, six feet high and three feet in diameter, of wood and raw hide, stuffed full of prayers written on dirty paper, and worked by waterpower. When the stream was turned on, this monstrous erection day and night rolled out five million prayers a minute, surely the simplest and easiest method for a community to acquire merit ever conceived of by the wit of man! Not content with this, there were numerous privately owned small hand prayer wheels lodged in crannies around the Fort, our resting place, while every other house had one or two so-called "prayer-horses," which consisted of a long flag staff or pole, with a long string of prayers on cloth

or parchment stuck down one side for twenty or thirty feet, which flapped continuously in the breeze, every flap turning out more prayers for the happy owner.

But other works there were of a more useful nature, notably a really wonderful tubular bridge of cane, built suspension fashion with a 120 foot span over the river, and light and fragile looking though it was, it stood the strain and weight of ten loaded coolies easily. It swayed as we crossed it, and one felt thankful it was only thirty feet above the river level, and not three hundred. On the sandy shore of the river under this bridge were the fresh marks and pugs of a fine leopard, the only signs of big game that we saw on the whole trip. The Monbas say that most of the leopards in their country are *black*! And it is a fact that of the two leopardse shot by Europeans up in those hills, one was of the black variety. Standing in the middle of the bridge one obtained a superb view of the whole valley, with the pine clad slopes stretching up 3,000 to 4,000 feet into the more sombre forests of Tsuga and evergreen oak of the higher levels, while below one's feet ran the river, whose waters were of such amazing clearness that every pebble and tiny fish in fifteen or twenty feet of depth was as clear as under glass.

The houses of the village were built mostly on pine wood piles and framework with roofs of wood shingles and walls of platted cane work, which seemed to form an inadequate protection against the chill winds of winter. They were all raised two or three feet above the ground level, and were uniformly brown from smoke and dirt. Only the Jong or Fort was built of stone, an imposing edifice from the outside, with 3 tiers of floors, connected together by the most primitive form of staircase, namely a notched tree trunk, and incredibly dark, dirty, and dismal inside, as there were no windows to give ventilation or light.

The Monbas are to a certain extent pastoral, and keep fine sturdy little cattle and ponies, also sheep and goats and poultry, but their cultivation, to anyone accustomed to the terraced cultivation of the hills, would appear very primitive. Terracing is scarcely attempted, hence permanent cultivation is confined to

the flats near rivers, but even here manuring is very inadequate and irrigation quite exceptional. This is surprising since they know sufficient to make water channels for their water-mills and the great prayer-wheel. Their staple crops are maize, barley and chillies, the latter grown for export to the plains, where they barter it for rice, salt and their other simple needs. But with good rice lands of their own not utilised, it seems a singularly uneconomical system of cultivation. Jhuming, or temporary cultivation of the hill-sides is common, and the ruination of the forests. Altogether one could not but be impressed with the general waste in the utilisation of the land, and the greater opportunities open to a higher form of civilisation.

After a day's halt we started our return march to the plains by a circuitous route. For two days we marched through priceless scenery of mountain, stream and forest, over precipitous limestone crags, by babbling brooks overhung with oak and pine and alder, through sombre forests of Tsuga and rhododendron, until we came again to the high outer ridge overlooking the plains ten thousand feet below. But we were cheated of the view by the dark mists which for eight or nine months of the year circle and eddy around these higher outer slopes. We passed several *mánés* or prayer walls, another common feature of the religiosity of these people. These are little stone walls about 8 feet by 4 by 3, with stones engraved with prayers, or perhaps engraved with the lotus flower and the figure of Buddha, and the traveller solemnly walks round the wall, muttering the well-known Buddhist prayer *Om máné padme hum.* These *mánés* are usually at the crests of passes, and always surrounded with scraps of cloth or even elaborate parchment drawings of devils, fastened to bushes or sticks. It is curious how from one end of the Himalayas to the other, the mountain passes are characterised by these little bits of fluttering rags. Do they in some mysterious way correspond to the Englishman's more prosaic "Thank God, we are up at last!"

On this march over the pass, our two Monba guides, who rejoiced in the wonderful names of Song Chering and Dirang Dzong, appeared to lose their sense of distance, and it was nearly

dusk when at last we reached a minute clearing, very much on a tilt, littered with the refuse of generations of ponies, damp from the everlasting mists and the all-pervading moss-clad forest, with quantities of wood that could not burn and a trickle of water that could not wash; not an ideal place for a camp, but we were far too weary to go blundering on into the night. And that night, to one accustomed to the seething swarming noisy life of the foothill forests of other parts of India, where all night and every night resounds to the jungle calls, to the alarm of the ever wakeful deer watching a prowling carnivore seeking his meat from God, to the ringing cluck of the perpetual nightjar, to the hoot of owls and the chirp of crickets, the tremendous absolute silence of those stark mist-laden evergreen forests was simply overwhelming Perched up there, in that tiny clearing, surrounded by league on league of primal trackless gloom, with never a sough of wind, or a star to be seen, or a sound to be heard, one feels like a disembodied spirit who has blundered into some dead forgotten planet, where the Creator had omitted to start the fertile fecund life of this sweet world of ours, and one is therefore the sole living intelligence in all that space of dark and deadly gloom, and with intense relief, the homely snore of a nearby coolie recalls us from the nightmare of our thoughts.

Next morning with joy we leave those gloomy heights, and plunge down for mile on mile through the verdant forest of fern and orchid and giant tree, and gloat over the roar of the mountain torrent, the babble of the white crested laughing thrush, and the ringing call of the barbette, to whom his mate answers perpetually in gentler chorus. Presently a pigmy otter puts up her sleek head and watches us, wonderfully tame for so shy a creature, but then she has nought to fear beyond the short range of the Monba arrow. Then a glimpse of a beautiful Malabar squirrel, in its furry coat of black and gold, scrambling up a climber to the top of a giant tree. A short march to-day, to make up for the super-exertions of yesterday, and we pitched camp in a glorious spot on the edge of a torrent whose waters, encased in the living greenery of the jungle, splash over great granite rocks into pools of clearest vivid green. The tent is pitched betweer the columnar

stems of gigantic trees, draped, not as yesterday in dull funereal moss, but in living orchids, ferns, a yard or more in length, and creepers with great clustering flowers of cream and mauve. The air is not so invigorating as in the drier inner hills, but languorous with the scent of jasmine, poignant with the odour of the over ripe elephant apple, warm and languid. And next day, down through the foot-hills, through ever new varieties of rank vegetation, of giant wild cardamoms and brakes of wonderful canes and palms, down to our first original camp.

And here, in the afternoon is held the annual ceremony of the exchange of gifts between the Monbas and the British Raj. Headed by a standard bearer, a piper or trumpeter, and 3 drums. a barbaric procession arrives of the several headmen of the chief Monba villages in gorgeous apparel, riding on gaily decorated ponies, with beautifully embroidered saddle cloths. These latter are taken off the ponies and placed in a semi-circle on the ground, and one is enabled to study the chiefs in greater detail. They are dressed in exquisitely embroidered silk coats of saffron and old gold, embroidered with blue and brown Chinese dragons. They have curious octagonal caps of black velvet and yellow silk, silver belts studded with turquoise, and swords in silver sheaths, and ornaments round their necks of bear claws and turquoise set in silver. Altogether they make a fine barbaric show, without a suspicion of being tawdry. The Monba presents amongst other curious things, included yaks, tails, bags of chillies, and woollen blankets ! After more than an hour of conversation, the meeting breaks up with mutual expressions of good will, and the procession forms again and wends its way back to their winter encampment in the foot-hills. And as the procession disappears for the last time, one ponders what the future holds for this cheery simple tribe, and how and when the evolution of man and of races will affect them.

And next day, with regret at every step we take to be leaving this wild and appealing land, we return along the little jungle track, back to motor roads, civilisation, and the latest doings of the politicians.

II.

A few notes on the scientific results of the trip will be of interest.

Geology.—The general geology of the tract is in rough outline much the same as any other section of the outer Himalayas, but differs in several instructive details. For a mile or more in width at the foot of hills, recent Bhabar deposits of large boulders and sand are found, the boulders chiefly of granite, quartzite and Tertiary sandstone, brought down by the existing rivers from the existing hills. The first outer hills, rising only 200′ to 400′ above the river-bed, consist of Siwalik sandrock and conglomerate (middle and upper Siwalik deposits), with a gentle dip to the North, and bounded on the North by a sharp reversed fault. One very interesting point about these conglomerates must be noted. The pebbles are never larger than oranges and consist very largely of pink, grey, and yellow quartzites with occasional slate fragments. They contain no traces of granite, and since the present streams are bringing down great boulders (from the size of footballs to the size of a taxi-cab) chiefly of granite, it is perfectly certain that when these upper Siwalik conglomerates were being deposited, the towering ridge of granite and gneiss which now forms the watershed a few miles away, did not exist, and we thus have a very interesting indication of tremendous earth movement, probably accompanied by granite intrusion, subsequent to or shortly after the deposit of upper Siwalik strata. This earth movement presumably coincided with the uplifting of the outer Siwalik ranges and formation of "Duns" (*e.g.*, Dehra Dun), but elsewhere in the Himalayas, there are few indications of earth movements of this period on such a scale as to produce great ridges which still, after enormous erosion (for the granite is coarsely crystalline and therefore deep seated), rise over 10,000′ within a few miles of the plains.

Crossing the reversed fault, we find an outcrop of Lower Siwalik (Nahan) sandstone, a still more ancient Tarai deposit, in this locality with the strata tilted almost vertically in parts. This rises to about 3,000′, and is bounded on the North by the great

reversed fault of the outer Himalayas, which runs without a break from Assam to the N.-W. Punjab. North of this again comes an outcrop of quartzites and occasional slates and metamorphosed schists, crushed, twisted, and intensely folded, and very reminiscent of the outer hills of Kumaon. The Northern boundary is concealed by the super-abundant forest growth, and the next rock formation to be noted is a great outcrop of granite and coarse gneiss, in parts distinctly augen-gneiss with felspar crystals 1" and more in diameter. This outcrop of gneiss extends from about 6,000' altitude, over the 10,000' pass, and down on the Northern slope for a mile or two, and is succeeded by crystalline quartzites, blue and grey limestones (which in appearance appear identical with the Deoban limestone of Chakrata and the blue limestone of Naini Tal), and occasional micaceous schists. These represent the typical rock systems of the lower Himalayas, but there was one new type of rock noted, which, it is believed, has not been recorded before, a very definite band of typical conglomerate, with pebbles of white and grey crystalline quartzite of the shape and size of billiard or tennis balls, embedded in a very hard grey siliceous cement. It was impossible to obtain a rock specimen, as nothing short of dynamite (which was not available) appeared to affect this steel-hard rock. The regular size and very round shape of the pebbles do not suggest the probability of glacial or ice deposit, and its origin must therefore be ascribed to river action, but how a typical river deposit occurs amongst these Pre-cambrian or Purana crystalline quartzites and limestones (hitherto regarded as the *earliest* of sedimentary, and probably deepsea deposits), and whose component pebbles prove the existence of pre-existing *quartzite* hills in the vicinity, appears inexplicable.

The geological section through the tract covered by the trip illustrates the above notes.

Horizontal scale 1" = 3 miles.
Vertical ,, 1" = 1 mile.

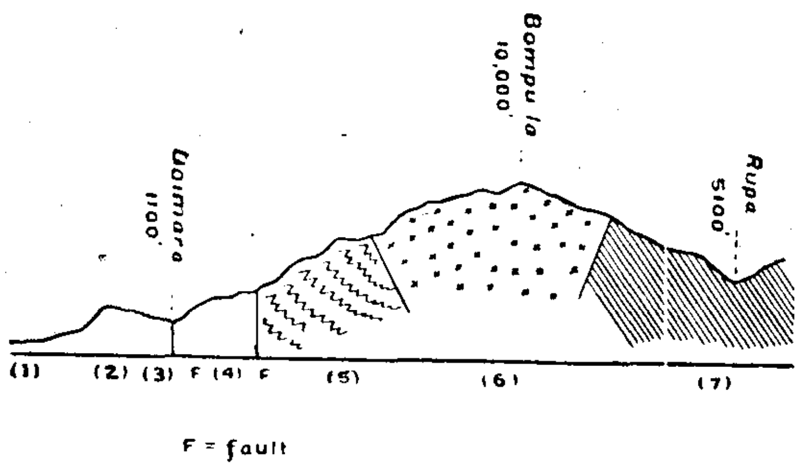
(1) Recent Bhabar and Tarai deposits.
(2) Middle Siwalik sandrock.
(3) Upper Siwalik conglomerate.

(4) Lower Siwalik sandstone.

(5) Slates, quartzite, and metamorphic schists (age ?).

(6) Augen-gneiss, Granite and gneissose schist possibly intrusive.

(7) Crystalline Quartzites, Limestone, Schists, and a thin band of definite conglomerate (Precambrian).



Flora.—The rush of the trip, the daily strenuous marches and the enormous height and straight bole of most of the forest trees, rendered it almost impossible to collect good botanical specimens, or to make anything except fragmentary notes on the flora of the different zones, but some of the commoner and more easily identified trees were jotted down, and may be mentioned.

(1) Oaks.—A very large variety of species, several of which could not be identified, but included the following :—

Q. lamellosa *Q. xylocarpa* *Q. fenestrata* *Q. lan.* (?)	3,000' to 6,000' in outer evergreen forests mostly confined to the ridges.
Q. pachyphylla *Q.* (near *pachyphylla*).	7,000'—10,000' on inner and outer slopes,

Q. semiserrata.
Q. glauca
Q. lanuginosa
Q. Griffithii
4,000′—8,000′ on inner slopes, mixed with Blue Pine. *Q. Griffithii* abundant and forming magnificent timber trees with clear boles to 80′ height in the ravines.

(2) Maples.—

A. Thomsoni—abundant at 7,000′—10,000′ on main outer range.

A. caudatum—6,000′—8,000′.

A. Campbellii—7,000′—10,000′.

A. villosum
A. niveun (?)
Outer evergreen forests, 5,000′—7,000′.

(3) Rhododendrons —

R. Falconeri—Common on main range, 8,000′—10,000′.

R. grande—Common on outer slopes 7,000′—9,000′.

R. arboreum—4,000′—8,000′ on inner slopes with Blue Pine.

R. Griffithianum (?)—7,000′ outer evergreen forest.

Miscellaneous broad-leaved species of the Pine zone—

Prunus acuminata.

Pieris ovalifolia—(abundant).

Berberis—(2 species).

Salix sp.

Betula alnoides.

Betula sp. (?)—(low level variety at 5,000′).

Alnus nepalensis—abundant, both on inner and outer slopes.

Zanthophyllum alatum—a striking thorny shrub.

Docynia indica—sporadic.

Conifers.

Tsuga Brunoniana—Forms pure forests immediately inside the main outer range, 10,000′ to 7,000′.

Taxus baccata—Sporadic trees 8000′—10,000′ on main ridge.

Pinus excelsa—The dominant trees of the inner slopes, 8,000′ to 4,000′.

Cupressus (?) (intermediate between *C. torulosa* and *C. funebris*). Forms pure crops on the limestones, grows to large dimensions, and tall, well grown on fertile slopes.

Cupressus funebris—Planted round villages.

Pinus longifolia was *not* found on the trip, but Captain Neville, Political Officer, informed me it was found further East at below 4,000'.

The conditions of soil, climate, etc , appeared ideal for Chir, and its total absence in the area covered was most surprising. Its place was taken by *P. excelsa* and to find this species growing gregariously as low as 4,000' was also unexpected.

Fauna.—The absence of animal life was most surprising, and the Monba country is not recommended for a Shikar trip ! The only animals actually seen were an otter, a Malabar squirrel, and a small brown rat-like squirrel with a short stubby tail. Tracks or marks were also noted of leopard, bear, gural, wild elephants (at 10,000'), a mythin (at 5,000') and a serow. The curse of the country were the little biting flies called Potus in Chakrata and Dim-Dams locally, found everywhere near streams or running water in incredible numbers, from 1,000' to 8,000' altitude, on both sides of the main ridge. The stream beds of the outer tropical slopes must be a paradise for the butterfly collector later in the year, while these slopes would probably also provide the orchid-hunter with cart-loads of beautiful species.

Possibilities of Economic Development of the Forests.

The writer was asked to report primarily on the possibilities of starting a resin industry in these pine forests. The general results of the enquiry may be briefly mentioned.

(1) A resin industry, *by itself*, could not be justified. The great outer ridge rising to 10,000', effectually prevents the possibility of constructing a cart-road into the pine zone, thereby seriously limiting the radius of profitable working. It is interesting to record that further to the East and to the West, where the high outer ridge disappears, and is replaced by a series of gradually ascending foot-hills the conifers disappear also, and are replaced by moist evergreen forests. Their presence in the Monba country is, I think, undoubtedly due to the fact that this high ridge catches most of the tremendous rainfall (on the outer slope

150" to 200" p. a.) and in the sheltered Tenga valley, I doubt if the rainfall exceeds 50". In the Tenga river, the difference in height between rains flood level and cold weather level is not more than 3' to 4'.

(2) The possibilities of profitable timber operations are more hopeful, and worth a wider examination of the further valleys than I was able to give. With splendid floating streams and rivers, a great waterway almost to Calcutta and the best coniferous timber adjoining the rivers, the primary condition of profitable extraction were excellent. But the almost complete absence of adequate local labour and of locally grown food crops, and the impossibility of importing sufficient food to feed imported labour on a large scale, were problems that would first have to be tackled.

(3) Under the most favourable conditions, it would require 2 or 3 years of fairly heavy expenditure to open up this tract, before any profitable returns could be expected, and recent orders of the Assam Government suggest that the present state of finances of the Province would stand the strain with difficulty.

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THE FOOD PLANTS OF INDIAN FOREST INSECTS.

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PART VII.

(*Continued from* " Indian Forester," *June* 1921, *pp.* 247—252.)

SCOLYTIDÆ.

Note.—The preparation of the records for this family has been delayed by the necessity for reconsideration of the identity of many species of Indian bark-beetles, particularly in the genera containing species described by Stebbing. Those of his species that are considered valid are included and the remainder have been assigned to synonomy, except in the large and difficult genera *Cryphalus* and *Xyleborus*. Both genera (sensu lato) require complete revision before the species of economic importance can be ascertained, and are therefore omitted for the present.

The species of *Hylastes* described by Stebbing, *i.e.*, *longifolia* and *himalayensis*, are not Scolytids, but Cossonids of the genus *Brachytemnus.*

I am indebted to Col. F. Winn Sampson for valuable assistance in identifying Indian Scolytidæ.

Carphoborus costatus, Wichh.*

Bark-borer.—*Pinus excelsa*, *Pinus longifolia*.

Distribution.—Chakrata, C. Almora, U. P.

Coccotrypes integer, Eichh.

Seed-borer.—*Diospyros Ebenum*, *Shorea robusta*.

Distribution.—[Siam]; Assam.

Crypturgus pusillus, Gyll.

Bark-borer.—*Abies Webbiana*, *Cedrus Deodara*, *Pinus excelsa*, *Pinus longifolia*.

Distribution.—[Europe; N. America; Japan]; Kashmir; Simla, Punjab; Chakrata, Tehri Garhwal, W. Almora, U. P.

Dactylipalpus transversus, Chap.

Bark-borer.—*Mesua ferrea*.

Distribution.—[Philippines; Celebes; Sumatra]; Lakhimpur, Assam.

Diamerus fici, Bldfd.

Bark-borer.—*Ficus elastica*.

Distribution.—Tista, Bengal.

Dryocoetes indicus, Steb.†

Bark-borer.—*Abies Webbiana*, *Picea Morinda*, *Pinus excelsa*, *Pinus longifolia*.

Distribution.—Simla, Punjab; Chakrata, Naini Tal, C. Almora, U. P.

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* The type of *Cryphalus boswelliae*, Steb., is in poor condition, but is evidently a *Carphoborus*. Stebbing's description and figures are however of a totally different insect.

† *Dryocoetes hewetti*, Steb., is an *Ozopemon*; *Dryocoetes minor*, Steb., is a geographical race of *Xyleborus natalensis*, Schauf.

Eccoptopterus sex-spinosus, Motsch.

Shot-hole borer.—*Shorea robusta.*

Distribution.—[Ceylon ; Java ; Sumatra ; Philippines ; Africa] ; Toungoo, Tharrawaddy, Burma ; Lakhimpur, Assam; Buxa, Bengal.

Hylesinus cingulatus, Bldfd. (Var.).

Bark-borer.—*Olea cuspidata.*

Distribution —Rawalpindi, Punjab ; Japan.

Hylesinus despectus, Wlk.

Bark-borer.—*Anthocephalus Cadamba.*

Distribution.—Ceylon ; Shwegu, Burma; Tonkin [Singapore ; Borneo ; Celebes ; New Guinea].

Hylesinus macmahoni, Steb.

Bark-borer.—*Olea cuspidata.*

Distribution.—Suliman Mountains, Baluchistan.

Ips longifolia, Steb.*

Bark-borer.—*Abies Webbiana, Cedrus Deodara, Pinus excelsa, Pinus Gerardiana, Pinus longifolia.*

Distribution.—Rawalpindi, Kangra, Kulu, Bashahr, Simla, Punjab ; Chakrata, C. and E. Almora, Ranikhet, Naini Tal, N. and S. Garhwal, U. P.

Ozopemon hewetti, Steb.

Bark-borer.—*Quercus dilatata, Quercus incana.*

Distribution.—Kangra, Punjab ; Chakrata, Naini Tal, N. Garhwal, U. P.

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* No one who has worked at the Indian species of *Ips* has yet been able to separate *ribbentropi* from *longifolia;* nor am I able to distinguish Stebbing's type and cotype of *blandfordi* from his *longifolia.* From an examination of metatypes of *I. stebbingi*, Stroh. I consider that this species must also be added to the synonomy of *longifolia.*

Phlœosinus squamulatus, Chap (?).

Bark-borer.—*Odina Wodier.*

Distribution.—Singhbhum, Bihar and Orissa.

Phlœosinus zhobi, Steb.

Bark-borer.—*Pinus Gerardiana.*

Distribution.—Zhob, Baluchistan.

Pityogenes scitus, Bldfd.*

Bark-borer.—*Cedrus Deodara, Picea Morinda, Pinus excelsa, Pinus Gerardiana.*

Distribution.—Suliman Mts., Baluchistan; Simla, Punjab; Chakrata, Tehri Garhwal, U. P. [Assam.]

Pityophthorus sampsoni, Steb.

Bark-borer.—*Pinus excelsa.*

Distribution.—Chakrata, U. P.

Polygraphus himalayensis, Steb.

Bark-borer.—*Pinus longifolia.*

Distribution.—Chakrata, C. Almora, U. P.

Polygraphus longifolia, Steb.

Bark-borer.—*Pinus longifolia.*

Distribution.—Chamba, Bashahr, Punjab; Tehri Garhwal, Chakrata, Dehra Dun, C. and W. Almora, N. and S. Garhwal, U. P.

Polygraphus [lepisomus] major, Steb.

Bark-borer.—*Cedrus Deodara, Picea Morinda, Pinus excelsa.*

Distribution.—Chamba; Bashahr, Simla, Punjab; Chakrata, Tehri Garhwal, U. P.

Polygraphus [lepisomus] niger, Steb.†

Bark-Borer.—*Abies Webbiana, Cedrus Deodara, Pinus excelsa.*

Distribution.—Kulu, Simla, Punjab; Chakrata, Tehri Garhwal, U. P.

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* *Pityogenes coniferæ*, Steb., is inseparable from *scitus*, Bldfd.

† Herr Oberforster Eggers has kindly supplied a metatype of *Polygraphus aterrimus*, Stroh., which shows it to be identical with *niger*, Steb.

Polygraphus pini, Steb.

Bark-borer.—*Abies Webbiana, Cedrus Deodara, Picea Morinda, Pinus excelsa.*

Distribution.—Chamba, Rawalpindi, Bashahr, Kulu, Simla, Punjab; Chakrata, Tehri Garhwal, West Almora, U. P.

Polygraphus trenchi, Steb.

Bark-borer.—*Pinus Gerardiana.*

Distribution.—Zhob, Suliman Mts., Baluchistan.

Progenius bidentatus, Motsch.

Shot-hole borer.—*Pterocarpus dalbergioides*

Distribution.—India; Andaman Isl.

Progenius laeviusculus, Bldfd.

Shot-hole Borer.—*Pterocarpus dalbergioides.*

Distribution.—Indo-China; Andaman Isl.; Mysore.

Ptilopodius ramosus, Samps.

Bark-borer.—*Hibiscus tiliaceus.*

Distribution.—Sunderbans, Bengal.

Scolytus deodara, Steb.

Bark-borer.—*Cedrus Deodara.*

Distribution.—Chamba, Simla, Punjab; Chakrata, U. P.

Scolytus juglandis, Samps.

Bark-borer.—*Juglans regia.*

Distribution.—Hazara, N.-W. F.

Scolytus major, Steb.

Bark-borer.—*Cedrus Deodara.*

Distribution.—Chamba, Punjab; Chakrata, Tehri Garhwal, W. Almora, U. P.

Scolytus minor, Steb.

Bark-borer.—*Cedrus Deodara.*

Distribution.—Chamba, Punjab; Chakrata, U. P.

Sphaerotrypes globulus, Bldfd.*

Bark-borer.—*Anogeissus latifolia, Lagerstroemia parviflora, Shorea robusta, Terminalia tomentosa.*

Distribution.—Dehra Dun, Lansdowne, U. P. Buxa, Bengal; Mandla, C. P.; Belgaum, Kanara, Bombay; N. Coimbatore, Madras.

Sphaerotrypes siwalikensis, Steb.

Bark-borer.—*Shorea assamica, Shorea robusta.*

Distribution.—Dehra Dun, Lansdowne, Ramnagar, Pilibhit, N. Kheri, Gonda, Gorakhpur, U. P.; Jalpaiguri, Buxa, Tista, Bengal; Goalpara, Lakhimpur, Assam; Singhbhum, Porohat, Bihar and Orissa; S. Mandla, C. P.

Sphaerotrypes tectus, Samps.

Bark-borer.—*Quercus incana.*

Distribution.—Chakrata, W. Almora, U. P.

Spongocerus darjeelingi, Steb.

Bark-borer.—*Quercus lamellosa.*

Distribution.—Darjeeling, Bengal.

Spongocerus kunala, Stroh.

Shot-hole borer.—*Quercus incana.*

Distribution.—[Kashmir]; Hazara, N.-W. F.; W. Almora, U. P.

Spongocerus pubescens, Haged.

Shot-hole borer.—*Quercus incana.*

Distribution.—Darjeeling, Kurseong, Bengal; W. Almora, U. P.

Strophionocerus minimus, Haged.

Shot-hole borer.—*Prunus armeniaca, Wendlandia tinctoria?*

Distribution.—Darjeeling, Bengal; Ranikhet, Jolikot, U. P.

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* See Beeson, Ind. For., 1921, pp. 514—518 for the synonomy of this genus.

Strophionocerus raja, Bldfd.*

Shot-hole borer.—*Abies Webbiana, Cedrus Deodara, Quercus incana.*

Distribution.—Chamba, Simla, Punjab; Mussoorie, W. Almora, U. P.; Darjeeling, Bengal.

Trypodendron intermedius, Samps.

Shot-hole borer.—*Abies Webbiana.*

Distribution.—Bashahr, Punjab.

Webbia Pabo, Samps.

Pin-hole borer.—*Shorea robusta.*

Distribution.—Kheri, Dehra Dun, U. P.

Webbia 26—spinatus, Samps.

Pin-hole borer.—*Dipterocarpus pilosus, Dipterocarpus tuberculatus, Mallotus albus.*

Distribution.—Pyinmana, Burma; Lakhimpur, Sibsagar, Assam.

Webbia 30—spinatus, Samps.

Pin-hole borer.—*Dipterocarpus pilosus, Dipterocarpus tuberculatus.*

Distribution.—Pyinmana, Burma; Lakhimpur, Assam.

Xyloctonus Scolytoides, Eichh.

Bark-borer.—*Bassia latifolia.*

Distribution.—[S. Africa]; Bombay.

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* *Scolytoplatypus-himalayensis*, Steb., is identical with *S. raja*, Bldfd.

CEDRELA SERRATA TIMBER.

The advantages which this timber possesses over timbers growing in the same localities are not generally recognised. It is fairly ornamental with a clean grain and very fast growing. It could probably be used for all purposes for which pine timber is used and for several other purposes in addition. It stands damp situations well and is nearly immune from white ants. In the latter respect it was recently tested for me by Mr. Cox in the Doraha Depôt, small pieces of the timber being buried with other species for six months, June to November. The following table gives the approximate degree to which each timber suffered from the depredations of white ants :—

	Percentage.
Deodar	*Nil*
Creusoted Silver Fir	*Nil*
Cedrela serrata	2
Pinus excelsa	10
Spruce	40
Pinus longifolia	55
Silver Fir	90

With the exception of the few outer rings of sap wood the white ants seem to attack the *Cedrela serrata* timber only on the radial surfaces, the longitudinal sawn surfaces being quite untouched. This is in marked contrast to the last four species mentioned above, the specimens of which were attacked indiscriminately throughout their length, and leads one to suppose that *Cedrela serrata* scantlings might be rendered entirely immune by protecting their ends.

According to Gamble, the timber weighs 33 lbs. per cubic foot as compared with 40 lbs. for *Pinus longifolia* and is about the same weight as *Pinus excelsa.*

The tree is a strong light demander, grows well in moist localities between 6,000 and 7,500 feet elevation and propagates itself profusely by seed. It has a very small crown in its youth

and should be grown in a fairly dense crop, but overhead cover must be avoided or crooked stems will result in the effort of the tree to reach the light. Probably 50 years would be a suitable rotation.

It would probably pay to give more attention to the growing of this species and to the placing of the timber on the market.

M. R. K. JERRAM, I.F.S.

PINUS MERKUSII.

This curious pine is common in the upper valley of the Thaungyin River, which is the boundary between Burma and Siam. It grows mostly with In (*Dipterocarpus tuberculatus*) and forms a striking feature in this very characteristic forest favouring often the higher land. The soil is usually sandy, sometimes consisting of little but gravel, and the pine seems to follow the In in certain parts, even on to the very poorest driest hills. Although it is small and poor in appearance in such places, it seems to be the dominating species wherever it occurs in any quantity, as, alike in the fairly good Indaing or In forest, and on the most-miserable dry ridges when it appears at all, it is the tallest and most conspicuous tree. One may walk for miles through the Indaing without seeing any pines at all and then find a single well grown tree on the top of a ridge, but as a rule it is gregarious, particularly on rather flat Indaing close to the Thaungyin River. Being the tree which gets the most light, it is sometimes found twined round by large climbers, especially *Butea superba*, and the pines in the poorest ridges have their branches covered with swathes of greenish lichen, like the Scotch pine in bad localities in Europe. These lichens are called by the Burmans, who use them as medicine, "Wind-Nests." The bark of the pine is very rough and dark in colour, and the crowns rather poor. It attains 10 feet in girth and 100 feet in height occasionally, but these sizes have only been found on the higher slopes. It

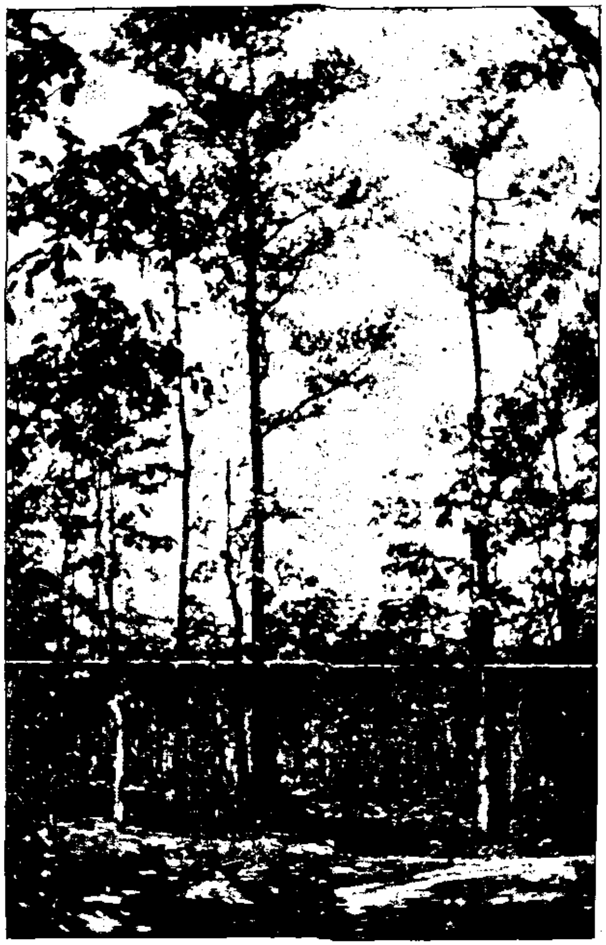

Photo.-Mech. Dept., Thomason College, Roorkee.

Photos by G. H. Ogilvie, M.C.

Pinus Merkusii.

nearly always grows on poor soil and the growth is naturally slow, as may be seen from the following measurements :—

No.	Height.	Girth at breast height.	Volume of timber cubic feet.	Annual rings.
1	70	3′ 3″	17	112
2	70	3′ 10″	25	95
3	60	2′ 7″	10	53

Two plots were measured up close to the village of Miba. In the first, half an acre, there were 7 pines between 4½ and 7½ feet in girth and 23 In trees as well as a number of small *Aporosa, Dillenia, Eugenia, Tristania, Irvingia, Pentacme* and *Anneslea.* Most of the In trees were between 2 and 3 feet in girth. Undergrowth was practically absent. Plot No. 2, 2 acres, was chosen in the densest pine area that was seen, and the numbers of trees above two feet in girth was as follows :—

Species.	Girth.					Total.
	2 —3′	3′—4′	4′—5′	5′—6′	6′—7′	
Pine ...	5	25	18	12	1	61
In ...	18	8	1	...	...	27
Pentacme ...	4	5	7	1	...	17
Others ...	6	2	2	2	...	12
	33	40	28	15	1	117

Others include *Irvingia Oliveri, Eugenia, Tristania,* and *Dillenia.* The volume of pine timber per acre would be about 1,150 cubic feet. The undergrowth consisted of a dense growth of young In trees in full leaf (at the end of April). No pine seedlings could be seen here or elsewhere as they are probably killed down by the fierce annual fires, and must only survive occasionally when, several favourable seasons give them a start. The pine seems to grow at 900 to 2,000 feet above sea-level. It yields plenty of good resin which is now being collected for the Empire

Exhibition of 1924, but it is unlikely that the resin will ever be important commercially as the tree is so scattered and labour is very scarce.

The photographs were taken by Mr. G. H. Ogilvie M.C., D. C. Forests.

A. RODGER, I.F.S.

STORAGE OF CONIFER SEED.

A most interesting experiment on the above subject has just been completed by Mr. C. R. Tillotson, Forest Examiner, United States Forest Service, and a full account of the results obtained is published in the American Journal of Agricultural Research for November 1921. As the subject is of supreme interest to Foresters in India and one about which very little is known in this country the following précis of Mr. Tillotson's experiments has been written for the benefit of those who are interested in this subject.

The experiment was started in 1909 when the United States Forest Service were handling enormous quantities of seed for their new reforestation scheme. Having collected as much as 63,000 lbs. of seed in a good seed year they were confronted with the problem of how to store the seed so that it would not deteriorate greatly in germinative ability and energy, even if kept for 4 or 5 years.

Fresh seed of six species with the wings removed was spread out thinly on a floor and fanned steadily for two days by means of an electric fan. The object was to dry the seed coats thoroughly. The species tested were *Picea engelmanni*, *Pinus monticola*, *Pinus contorta*, *Pinus ponderosa*, *Pinus strobus* and *Pseudostuga taxifolia*.

Each lot of seed (the lots varying from 10 to 70 lbs. according to the size of the seed) was divided roughly into portions of about 600 to 800 seeds each and these were distributed equally among the following containers :—

(1) Ordinary manila paper coin envelopes.
(2) Similar envelopes soaked in melted paraffin.
(3) Cotton cloth bags.

(4) Similar bags soaked in boiled linseed oil and dried.
(5) Glass bottles which after filling were sealed air-tight with paraffin.

Seed of all six species stored in each of the five containers constituted one test set of samples and in order to determine whether seed deteriorated in storage to a greater extent in one geographical region than in another three sets of samples were sent to thirteen different places widely scattered over the United States. These thirteen storage centres varied in elevation from 30 feet to 9,000 feet above sea level. Another point on which it was hoped this experiment would throw some light was the effect of several conditions of temperature on seed in storage. At each of the geographical points mentioned therefore, the co-operators in the experiment were requested to store the three sets of samples in places where the following conditions of temperature would prevail:—

(1) Ordinary indoor temperature, such as an office shelf where the temperature would always be above the freezing point.
(2) Fluctuating temperature, as in an out building or unheated garret where the temperature would follow rather closely the actual outdoor variations. Proximity to a stable was to be avoided.
(3) Fairly uniform low temperature such as prevails in an unheated basement or cellar.

The experiment was planned to cover a period of approximately 5 years. The seed was sent to the 13 storage stations during March 1909. In January 1910 and again in January 1911, 1912 and 1914 three test sets (one from each of the three temperature conditions) were sent by express to Washington for testing.

It is thus seen that the germination tests were carried out after the seed had been in storage for periods of approximately one, two, three and five years. It was considered unlikely that seed in commercial quantities would be stored for a longer period than five years but as a matter of interest a few of the seeds were replaced in their respective containers and carried over for another 5 years. These were tested in 1919 and the germination results are

given at the end of this article. The seed testing at Washington was perfectly simple and straightforward. Two hundred seeds were used in each test. Ordinary green house wooden flats about 14″ × 18″ × 4″ were filled with fresh sand, the seed was scattered uniformly over the surface and covered with ⅛ to ¼ inch of sand. The sand was kept moist during the course of germination by sprinkling water through a fine rose when required and the temperature was kept at about 70° Fahr. during the day time and about 50° Fahr. at night. There were of course variations in the temperature and on occasions 100° Fahr. was recorded on hot days. A daily record of the germination was kept and as the seeds sprouted and developed a short radicle they were plucked out of the sand and discarded. Although it is impossible to give the detailed figures of each part of the experiment in this short article, the following conclusions are given in full as recorded by Mr. Tillotson and tables giving the average germination per cent. for seed stored in different containers and under different temperature conditions and also the average germination per cent. for all 4 years at the different elevations. The actual variations in the results obtained for the different species have no special interest to Foresters in India and the results have been amalgamated and given as an average. It must be remembered however that this experiment has reference to Coniferous seed only and that they are based upon the results of one series of tests with only six species and may not be applicable to all coniferous seed even in America and far less so in India. This however does not affect the main idea of the experiment which is to show the comparative preservative powers of different containers, the effect of altitude on the storage of coniferous seed, and effect of storing in various conditions of temperature.

The conclusions arrived at are instructive and should prove interesting to forest officers in India where so little is known about seed storage.

It should be remembered that the seed used was thoroughly air dried before it was placed in air-tight storage.

(1) Storage of coniferous seed in the air-tight bottle is far superior in every respect to storage in any other container. The

average germination for the 5 years period of seed stored in bottles over that stored in the next best container is 22 per cent.

(2) Thoroughly air dried coniferous seed stored in air-tight bottles is little if at all affected by such differences in temperatures as exist between a locality where the temperature follows the natural fluctuations, a locality indoors where the temperature never falls below freezing, and a locality in an ordinary cellar or basement.

(3) Coniferous seed stored in air-tight bottles is little, if at all, affected by the geographic locality of the storage point.

(4) The quality of coniferous seed, by which is meant its value in terms of both germinative energy and germinative ability, is much superior in the case of seed stored in an air-tight bottle to that stored in any other receptacle. This is manifest even at the end of one year of storage.

(5) Following the air-tight bottle, the various containers, in the order of their merit fall into the following sequence (*a*) paper bag paraffined, (*b*) paper bag, (*c*) cloth bag, (*d*) oiled cloth bag. It should be noted that an ordinary paper bag closed at the top is superior to a cloth bag for seed storage. An oil cloth bag is practically worthless as a container.

(6) The use of any containers other than air-tight results in such rapid deterioration after one or two years of storage as to render the seed of very little worth.

(7) Storage at the indoor temperature is superior to that at the fluctuating or low temperatures. Storage at the low temperature shows the poorest results. This low temperature has reference not to a low uniform temperature of freezing or less but to that of an ordinary cellar or basement.

The difference in germination percentage is not great under these three conditions but is sufficient to make indoor storage preferable to the other two conditions.

(8) Places of relatively high altitude and of low humidity are more favourable for seed storage than those of low altitude and high humidity. The latter should be avoided, if possible, where ordinary methods of storage are followed but when seeds are stored in air-tight bottles the difference is negligible.

TABLE I.

Germination percentages of seed stored in different containers and under different temperature conditions.

Temperature and containers.	Average for six species of conifer.				Average for all 4 years.
	1910	1911	1912	1914	
1. Fluctuating temperature—					
Paper bag	48·1	37·5	23·1	17·8	31·6
Do. paraffined	49·4	40·6	25·1	20·5	33·9
Cloth bag	40·5	30·0	19·9	14·9	26·3
Do. oiled	27·3	20·0	14·5	10·0	18·0
Air-tight bottle	60·3	58·5	51·1	48·8	54·6
Average for all containers ...	45·1	73·3	26·7	22·4	32·9
2. Indoor temperature—					
Paper bag	51·3	40·7	26·5	17·8	34·1
Do. paraffined	55·5	41·9	28·3	21·3	36·8
Cloth bag	43·7	32·9	21·3	13·6	27·9
Do. oiled	31·1	23·7	16·3	9·7	20·2
Air-tight bottle	60·6	57·7	49·3	51·1	54·7
Average for all containers ...	48·4	39·4	28·3	22·7	34·7
3. Low temperature—					
Paper bag	40·8	27·6	15·9	12·3	24·2
Do. paraffined	45·9	31·1	18·9	14·3	27·6
Cloth bag	35·0	23·4	13·7	11·1	20·8
Do. oiled	23·2	15·9	9·3	9·1	14·4
Air-tight bottle	62·1	57·4	49·8	50·6	55·0
Average for all containers ...	41·4	31·1	21·5	19·5	28·4

TABLE I.—(*contd.*)

Temperature and containers.	Average for six species of conifer.				Average for all 4 years.
	1910	1911	1912	1914	
4. Average for all 3 temperatures—					
Paper bag	46·7	35·3	21·8	16·0	30·0
Do. paraffined	50·3	37·9	24·1	18·7	32·8
Cloth bag	39·7	28·8	18·3	13·2	25·0
Do. oiled	*27·3*	*20·0*	*13·4*	*9·6*	*17·6*
Air-tight bottle	61·0	57·7	50·1	50·2	54·8

This table brings out the striking superiority of the seeds stored in air-tight bottles. This is particularly true when the storage period extends beyond one year. It seems safe to assume (barring any hypothesis of post ripening of the seed during storage) that the germination of the seed before it was put in storage was at least equal to that of the seed stored in bottles at the end of one year. Based on this assumption Table I shows that the average deterioration for all species at the end of 5 years, is for seed stored in a paper bag, 45 per cent.; in a paper bag paraffined, 42·3 per cent.; in a cloth bag, 47·8 per cent.; in a cloth bag oiled, 51·4 per cent.; and in the air-tight bottle, 10·8 per cent. These figures are interesting and indicate that on the average an ordinary heavy manila type of paper bag, if tied at the top is superior to an ordinary cloth bag. If the paper bag can be treated with a coat of paraffin, it will be still better. The oiled cloth bag is decidedly inferior.

Of the three conditions of temperature under which the seed was stored Table I clearly indicates that the highest average germination percentages were secured with that stored at the indoor temperature. The differences in the average germination percentage for the indoor and fluctuating temperatures is only 1·8 per cent. but the superiority of indoor temperature conditions over

those in an ordinary basement or cellar is indicated by an average excess germination of 6 per cent. This general superiority was consistent with all of the six species tested. Here again, the superiority of air-tight storage is evidenced by the fact that the seed stored in bottles at the low temperature shows no inferiority over that stored under indoor and fluctuating temperature conditions.

TABLE II.

Average germination per cent. for 4 years for all containers at various altitudes.

Serial Number.	Altitude.	1910	1911	1912	1914	Average for all 4 years.
1	30 ft.	43·7	26·3	19·0	13·8	25·7
2	400 ,,	36·8	34·6	14·5	13·1	21·7
3	600 ,,	41·7	34·6	24·2	19·1	29·9
4	700 ,,	38·2	32·5	21·6	15·6	27·0
5	800 ,,	34·5	25·2	18·4	11·8	22·5
6	800 ,,	45·1	39·2	25·8	21·5	32·9
7	875 ,,	46·1	32·5	28·0	21·4	32·0
8	1,150 ,,	43·4	30·9	24·0	19·0	29·3
9	1,600 ,,	49·6	43·5	30·2	25·8	37·3
10	2,700 ,,	44·8	42·2	24·8	20·8	33·2
11	4,500 ,,	52·0	42·9	33·0	28·3	39·0
12	6,500 ,,	55·8	55·6	38·0	35·5	46·2
13	9,000 ,,	53·3	39·0	34·9	35·3	40·6

This table indicates that the higher altitudes have on the average a greater germination per cent. but it seems probable that other climatic factors have their effect on the physiological activities of the seed. Numbers 12, 13, 11 and 9 are all places of low relative atmospheric humidity and numbers 2, 3, 4 and 5

are all places which experience severe temperature fluctuations and have a high relative atmospheric humidity.

There is, however, comfort for those wishing tc store seed in such localities when the germination of bottle stored seed is examined. Based on the average germination percentage of such seed for all species and all years the different altitudes show the following percentages for bottle stored seed and for comparison that of seed stored in cloth bags.

Serial number.	Altitude.	Average germination per cent. of seed stored in air tight bottles	Average germination per cent. of seed stored n cloth bags.
1	30 ft. ...	52·6	18·3
2	400 ,, ...	52·2	9·7
3	600 ,, ...	56·0	20·6
4	700 ,, ...	59·1	16·0
5	800 ,, ...	54·8	13·2
6	800 ,, ...	53·7	25·8
7	875 ,, ...	53·0	23·5
8	1,150 ,, ...	52·3	23·0
9	1,600 ,, ...	53·1	33·2
10	2,700 ,, ...	54·4	25·3
11	4,500 ,, ...	54·4	36·6
12	6,500 ,, ...	57·5	44·1
13	9,000 ,, ...	55·6	39·0

The above clearly indicates that the bottle stored seed was not affected by the various climatic conditions. The geographic location and the altitude seem to have little or no effect on seed thus stored. On the other hand the effect of the geographic location is clearly indicated on the seed stored in cloth bags where there is a difference of 34·4 per cent. between the germination per cents. of the 400 feet and 6,500 feet altitudes.

Results of Storage at the end of 10 years.

Reference was made at the beginning of this article to the fact that some of the stored seed was carried over for another 5 years and then tested again. Following the test of 1914, the bottles were resealed air-tight and then stored until January 1919, on a shelf in the Forest Service Office building at Washington. Owing to the fact that the seed was exposed to the air at the end of 5 years, although the bottles were afterwards resealed, this part of the experiment does not truly indicate whether seed can be successfully stored for 10 years without great deterioration. It does however give an idea of the relative sustained vitality of the species concerned and of the fact that certain species of conifers do retain their vitality for 10 years or longer.

Species.	Germination per cent.	
	1914	1919
Picea engelmanni	71·5	*nil.*
Pseudotsuga taxifolia	43·0	*nil.*
Pinus ponderosa	82·0	22·0
Pinus contorta	61·5	9·0
Pinus monticola	74·0	6·5
Pinus strobus	56·5	*nil.*

H. TROTTER, I.F.S.

SILVICULTURAL NOTES.

NOTE ON ESTABLISHMENT OF SAL SEEDLINGS UNDER USUAL FOREST CONDITIONS.

The measurements recorded below refer chiefly to seedlings of the 1913 seed year, which was an altogether exceptional seed year throughout the U. P.

Small plots 10′ × 10′ or 15′ × 15′ were laid out in various divisions, the seedlings counted, and measurements made periodically. There was no tending of any description, the plots selected

were taken up haphazard and usually under moderate to heavy overhead shade. The following examples illustrate the general results obtained :—

Division.	No. of seedlings on 1-12-1913.	No. of seedlings on 1-12-1921.	Maximum ht.	Mi. ht.	Aver ht.	Per cent. of survival.	REMARKS.
Bhinga Range, Bahraich, 5 plots (1,020 seedlings).	1,020	150	30"	6"	16"	7%	Haldwani plots only laid out in 1921, but seedlings known to be chiefly from 1913 seed year.
N. Kheri, 16 plots, 5,480 seedlings.	5,480	800	26"	5"	13"	7%	
Haldwani (Lakhmanmandi), 3 plots.	?	500	36"	5"	12"	?	
Total average. ...	...	950	24"—42"	5"—6"	12"—6"	?7	

Types of Forest—N. Kheri ... Damar type good II Q.
Bahraich ... Plains type III Q.
Haldwani ... Bhabar type I to II Q.

These measurements indicate for normal forest conditions starting with an exceptionally good sal seed year :—

(1) 7 per cent. survive for 8 years.

(2) of this 7 per cent. not more than about 10 per cent. get into the whippy stage (*i.e.*, 2½' height) in 8 years.

(3) The average of the 7 per cent survivors become 12" to 16" height in 8 years, *i.e.*, they are not yet established.

These measurements confirm the conclusions already arrived at by Mr. Hole and other investigators, that the establishment period of sal seedlings under ordinary forest conditions is an extremely slow process, but that a certain proportion of seedlings continue to hang on and exist for a long period.

These plots are being kept under observation, but have been divided into a variety of different methods of experimental treatment, to see how the growth of partially established seedlings can be accelerated.

The experimental methods of treatment now being tried include (1) Complete clear felling.

(2) Shelterwood.

(3) Original canopy left intact.

(4) Annual burning.

(5) Cutting back flush with the ground.

(6) Unburnt and not cut back.

(7) Shrubs, etc., cut back in the cold weather.

No intensive rains weeding is being attempted, as this is believed to be impracticable over thousands of acres.

Interesting results may be expected in 3—5 years.

E. A. SMYTHIES,
Silviculturist, U. P.

REVIEWS AND EXTRACTS.

FORESTS IN RELATION TO STREAM-FLOW AND EROSION.

One of the common marvels to the ordinary person is that so little is really known about such an every-day phenomenon as rain-fall. It is a satisfaction to remember that, thanks to the British Rainfall Organisation, more is known of the rainfall of Britain than of any other country, but our complacency may be a little disturbed when we reflect that for investigations as to what happens to the rain after it falls we have to turn to other lands. Water-engineers indeed have data from which much might be learned; but water-engineers are secretive folk, and the records of investigations on the run-off of the Severn, Exe, and Medway remain the only records generally accessible. The results of these investigations, though extremely valuable, are not, however, very definite, as the areas are so large and the problems correspondingly complicated. More definite results are to be expected from the experiment being carried out by the United States Depart-

ment of Agriculture in Colorado*. The areas dealt with are small and the problem more defined, though even in the small areas there studied conditions are by no means so simple as might be desired.

The intention of the experiment planned in 1909 was to make a complete study of the effects of forest cover on stream-flow and erosion. The main idea of the method employed is simple enough. It was, to select two small forest-covered valleys, contiguous, of the same size, similar and similarly situated, to find the rainfall and run-off from each, then cut down the forest from one of the areas and repeat observations. It appears almost a laboratory experiment. The first trouble was the trouble of the cook who desires to cook a hare, or perhaps it would be better to say, a brace of grouse, and it must be confessed at once that though two somewhat similar birds were caught they were not of the same kind, and as investigation proceeded unexpected anatomical differences presented themselves, extremely interesting in their own way, but not making for uniform cooking; it appears also that even if they had been both of a kind they were particularly difficult birds to cook. The valleys chosen lie about the 10,000 feet level in a region with precipitation about 20 inches a year, about half of which falls as snow and a goodly proportion of the rain in thunderstorms, both phenomena introducing difficulties.

The publication before us is a preliminary report giving an account of the first part of the experiment from 1911 to 1919, and discusses the data obtained while both valleys, A and B, were forest covered. Both valleys are small, B of 200 acres and A a little larger, varying in elevation from just over 9,000 feet to just under 11,000 in the case of B, and somewhat over in the case of A. The geological structure is identical, namely, augite-quartz-latite, little porous to water, covered with a few feet of soil and decomposed rock, porous and sandy in texture, forming a permeable and well-drained top layer. The forest cover,

* "Stream-flow Experiment at Wagon Wheel Gap, Colorado," Monthly Weather Bureau Supplement, No. 17. Government Printing Office, Washington, 1922.

conifers of various kinds, is almost identical. The valleys are not, however, of quite the same shape—A is long and narrow, B is much more like a bowl; the exposure is rather different, the centre line of A being south of east, while that of B is north of east. This is important in view of the fact that the winter snowfall runs off as it is melted by the summer sun, and indeed both the time and degree of response of the two streams to any factor influencing the *régime* are somewhat dissimilar. For example, after rainfall A rises more rapidly and reaches its maximum flow earlier than B, B may then be higher than A for a time, while at the end of the flood A may be higher than B. As a result, it has been necessary to construct tables and diagrams to show the relation of B/A for a great variety of conditions, and some 16 "rules" have been formulated for comparing the discharge of B when the discharge of A and the rainfall is known.

The readings for the run-off may probably be accepted. Very great care has been taken to construct suitable dams, gauges, and basins. The construction of the measuring apparatus is described in great detail, and the readings appear in general to have been exceedingly accurate and trustworthy. But it is a little difficult to place implicit confidence in either the precipitation statistics or the use that is made of them. Though details are, perhaps significantly, lacking, it is evident that the exposure of the gauges for rain and snow is not up to the standard required in this country, while their distribution also leaves something to be desired. Only five were set up in the two valleys; two are close together in the lower part of each basin and one at almost the highest point of A, while a sixth was just outside the lower portion of both basins.

The number would, of course, be abundant for ordinary rainfall work, but in a scientific experiment which is otherwise worked by accuracy, British experience would suggest that the number was inadequate, and we should imagine that over a vertical height of 2,000 feet there would be considerable differences in rainfall, especially when a good proportion of the rain falls in thunderstorms. It is possible that conditions are different in

Colorado, but we should have been more satisfied if evidence had been adduced to show that this was so. Nor is our confidence increased when we learn that in the second part of the experiment, when the forest is removed from B, only the gauges in the A valley are to be read. It is scarcely sufficient to say that "the use of the single record cannot be seriously objected to when it is considered that at the lower end of A there is the *choice of the better catch* of two gauges, and this value is *averaged* with the catch of the third gauge at the head of the valley." The italics are ours. It is only fair to say that much more care has been taken with another and equally important side of the problem, the melting of the snow. Observations of the depth of the snow at the time of thaw are taken at a considerable number of points.

It will be interesting to see in ten years' time the results of removing the forest. No doubt valuable results will be obtained, which will be of use in dealing with the Forest Reservations of the Rockies, but even so, light will be thrown on only a small portion of the small problem. We shall know what is the effect of removing forest cover only under somewhat special conditions. There will be plenty room for further investigation.—(*Nature*, No. 2735, Vol. 109.)

A SIMPLE KEY TO ONE HUNDRED COMMON TREES OF BURMA, BY C. B. SMALES.

Bitter experience makes a forest officer very suspicious of short-cuts. We all have tried them and remember the hornets nests, cane brakes and other dead ends to which they have led us and in most cases the botanical short cut is no better than its land counter-part.

In this booklet we have found a short-cut which will save much weary floundering amongst the various Floras to those who are starting to get to know their trees in Burma and should come in handy to those of riper years who would fain hide from themselves the fact that they don't know their common trees and dare not trust to Lace's list.

The Key which is based on Haines' "artificial key" does not require any specially trained powers of observation but on the other hand the search for some of the minor characters used in the key will probably lead to the beginner observing field characters of his trees much more closely than if he had to work with a regular Flora.

The author has successfully avoided the use of botanical terms as far as possible but he would have done well to include in his glossary the corresponding adjective or substantive to some of the less easily recognised terms. One can imagine a beginner being somewhat puzzled to distinguish between leaflets and pinnae in the section leading to "Pyinkado" for instance.

The reviewer has no hesitation in recommending the book to newly joined forest officers and members of the timber firms and in support of his recommendation is able to refer to his own experience. Although his botanical knowledge is only of the order which allows of his distinguishing a coccanut from a cabbage when they are in close juxtaposition he has been able successfully to identify a tree with the help of this book.

Photo-Mech. Dept., Thomason College, Roorkee.

Photo by George Raymond, M.V.O.

OLIVE TREES IN CORFU.

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OLIVE CULTIVATION IN THE IONIAN ISLANDS.

Homer in the *Odyssey* relates how Ulysses spent eight years on the island of Ogygia philandering with the nymph Calypso, who desired him to marry her, promising him immortality and eternal youth. Ulysses, evidently a little weary of Calypso after eight long years of her society and wondering fearfully what would happen to him if Penelope ever got to hear of it, decided to make a bolt for home. He was much too wise to risk a scene and too much of a gentleman to leave his hostess without saying good-bye. In those days it was as well not to trifle with the affection of ladies who were quite capable of turning their faithless lovers into swine or other uncomfortable metamorphoses. Therefore Ulysses sought the intervention of his protectress Athena. Thus it came to pass that Hermes carried to Calypso the command of Zeus to dismiss Ulysses. The nymph had to obey and moreover taught him how to build a raft on which he left the island. In eighteen days he came in sight of Scheria, the island of the Phæacians, when Poseidon sent a storm which cast him off the raft, but he managed

to swim ashore. Our exhausted hero slept on the shore until he was awakened by the voices of Nausicaa and her maidens playing ball. After the necessary introductions had presumably been effected Nausicaa carried him off to the court of her father King Alcinous and his queen Arete. However, having Penelope in mind he informed his hosts that he could not stay and soon took ship for Ithaca.

On a brilliant morning in late January I, with one companion, found myself on the self-same island of the Phæacians, much exhausted after a night's tossing on the strait of Otranto. After a few hours rest in the very comfortable Hotel d'Angleterre et Belle Venise, we were discovered by Nausicaa in the person of the charming daughter of the British Consul and were duly conducted to the residence of her parents. Having no Penelope in the background, we decided to stay, as the island appeared to be a most delightful haven of rest after our devious wanderings from the East.

For a returning exile from India, anxious to avoid the rigours of a northern winter I can recommend no better place for a month's holiday than Corfu, the largest of the Ionian Islands. Hotel accommodation is very comfortable and surprisingly cheap. The inhabitants, who are kindness personified invite a stranger to share in all their amusements if he is so inclined. Dancing, tennis, bridge, and if one is lucky an occasional shoot on the mainland are all to be had, to say nothing of the delightful walks through scenes of Aradian loveliness. The climate in January is cold but brilliant. It sends the blood coursing through the veins. It calls to the sun-dried bureaucrat to cast off his cares and march away, knapsack on shoulder, through olive groves carpeted with daisies, crimson pasque flower and golden oxalis, to the western cliffs of Pelekon. The roads were constructed by the British during their fifty years occupation of the Ionian Islands and are therefore well graded but the atrocious surface makes driving much less comfortable than walking. An interesting place to visit is the Achilleon, built by the ill-fated Empress Elizabeth of Austria and purchased a few years before the war by the Kaiser

Wilhelm II of Germany as a winter residence. The building itself is a typical example of Teutonic garishness but it is set in the loveliest garden imaginable descending in terraces to the limpid waters of the Ionian sea. The exquisite colours reflected by the sunset on the mirror like surfaces of smooth water between the island and the mainland must be seen to be imagined. In the brilliant light of noon the waters are dark blue backed by the gleaming snows of the Albanian mountains. At evening the colours change to delicate shades of pink, emerald green, and purple. Brown and white sails of native fishing craft give an ethereal quality to the scene which seems more allegorical than real.

Olive cultivation is one of the principal industries of the islanders. My interest was stimulated by a fortunate meeting with Count John Sordina, a local landowner and keen arboriculturist. Thanks to his kindness I was able to acquire a good deal of interesting information on the scientific cultivation of the olive, though he was careful to inform me that his own countrymen are somewhat backward in up-to-date methods.

When I landed in Corfu, the country was much excited by the return of King Constantine to the throne. The inhabitants rose as one man to welcome him. Whatever may be said about his conduct during the late war there is no doubt whatever that he is a Greek before everything else and enjoys immense popularity with all classes. The Queen, because of her relationship to the Kaiser, was much censured by the allies but every true lover of Greece cannot but be grateful for her untiring efforts on behalf of her adopted country. Chiefly through her efforts agriculture and forestry societies have been founded, to sow modern ideas among the struggling peasants with the object of improving their lot and making the country self-supporting. The pine forests of Thessaly are being brought under Working. Plans and the barren hills of Attica afforested with careful attention to the most suitable species. When in Athens I saw acres and acres of thriving plantations round and on the slopes of the Pnyx Hill and the Areopagus where St. Paul is said to have disputed with

the Athenians on their unknown gods. If the good work is allowed to continue the country will in time regain its forests so celebrated in classical times and which have been destroyed by unrestrained cutting and grazing during centuries of Turkish misrule. It is unfortunately necessary to record that much of the good work was dissipated during the Venezelist *régime* but the return of the royalists to power has rekindled the hopes of foresters and agriculturists. Their societies of which Count Sordina is a prominent and active member are again flourishing. The Royal Agricultural society of Greece issues instructional pamphlets, for the use of cultivators, on such subjects as cereals, vines, olives, bee-keeping, silk-worms and all matters of interest to the tiller of the soil. The pamphlets are sold for the nominal price of 20—30 leptae equal to about two pence at the normal rate of exchange. The pamphlet on olive culture was written by Count Sordina himself, who very kindly presented me with a copy. In addition to writing me a special note on the olive he personally conducted me round his estate and showed me all his experiments. I discussed with him the possibility of introducing olive into India, not being aware at the time that such had already been done. I do not know how the experiment is progressing but I shall be glad to place what information I collected at the disposal of any one interested in the subject.

The olive has been cultivated in Greece, where it was first introduced into Europe from Syria, since the dawn of history. Its presence in the garden of Alcinous at Scheria is alluded to in the Odyssey. Its importance is illustrated by the following legends. When Athena and Poseidon were both contending for the possession of Athens the gods resolved that whichever of them produced a gift most useful to mortals should have possession of the land. Poseidon struck the ground with his trident and straightaway a horse appeared. Athena then planted the olive. The gods thereupon decreed that the olive was more useful to man than the horse and gave the city to the goddess from whom it was called Athenae.

It is probable that the Olive (*Olea europea*) reaches its highest quality in the Ionian Islands where the conditions are ideal for

it. The illustration accompanying this article gives a very good idea of the characteristic appearance of the tree in its semi-wild state. Notice the grotesquely pitted surface of the trunk, only apparent in old trees and resembling in appearance the epiphytic figs of India.

In Corfu the olive tree puts on new growth only in winter and spring, resting in the dry hot summer months from June to September. The period of rest is very important. Without it an excessive number of lateral shoots would be formed at the expense of the terminal shoot. The fruit-giving quality of a tree can be determined at a glance by the length of the internodes. Trees with drooping branchlets having long clean internodes give much more fruit than trees with short, bushy and upright branchlets. It would be useless to try and grow the olive for fruit in a climate where no resting period could be assured. It matters not whether it is the summer or the winter but it must be remembered that the fruit cannot stand a temperature of much below freezing point. Cold winds, especially at high altitudes, will prevent the flower from setting properly and will cause abortion of the greater part, if not all, of the fruit.

The tree shows a marked preference for calcareous soils but it can grow on almost any soil except heavy and tenacious clays. Count Sordina in his work *L'Olivier a'Corfu Montpelier 1911* gives some very interesting information on the behaviour of the olive on different soils. According to his researches the best olives, giving heavy and regular crops of magnificent quality, are found on masses of limestone ntercallated with calcite and gypsum, the soil being deep, red, moist and rich, having more clay than sand. Very dry soils unable to retain moisture are just as useless as heavy, impermeable clays on which water lies for a long time and stagnates.

I was interested in learning that the quality or quantity of the fruit crop bears very little relation to the quality of the trees. Poor trees may often give fruit in great quantity but inferior quality and *vice versa*. On the other hand large flourishing trees may give a poor yield of good fruit or a high yield of

inferior fruit. The quality of the oil is also sometimes quite independent of other factors. It soon became evident to me that an amateur would be ill-advised to dabble in olive culture.

In the Ionian Islands the tree does not bear fruit much before the eleventh year after which the yield rises from 300 litres of oil per hectare at the eleventh year to 650 litres at the thirty-seventh. The Italians, who are probably the best olive cultivators in the world, obtain as much as 8,500 lbs. of fruit from 100 full grown trees giving a yield of 548 to 840 kilos oil per hectare.

According to Count Sordina the best way to propagate the olive is to graft a carefully selected variety on seedlings of the wild olive, *Olea Oleaster*. There are very many varieties suitable for different parts of the Mediterranean region. The young stocks are carefully removed from their natural environment, with plenty of roots, preferably in balls of earth, and planted in large holes, after pruning off broken roots with a sharp knife. The planting hole is filled with earth from the surface of the ground and mixed with liquid manure. The young plant is tied to a stake to prevent it from being blown over by the wind, and the earth pressed down from time to time with the hands, never with the feet. Watering is done every two or three days. The best time for planting is from February to March but in very dry, hot localities where there is practically no water in summer, planting is sometimes done after the first rains in October. The mildness of the winter in Crete and the most southerly of the Ionian Islands enable planting to be done as early as January.

The stocks are sometimes raised from seed. Very ripe fruit is taken and allowed to rot in heaps when the stone is easily separated from the pulp. Another way is to immerse the fruit in a bath of soda which removes all traces of the oil which retards germination and the stone is cut, care being taken not to injure the embryo. If germination is required the same year the embryo is removed bodily from the stone and kept in a mixture of sand and dung and put out in April.

Space is insufficient to describe in detail the method of grafting the scion on to the stock. Several methods are employed but they are all simple. Further particulars can be given if desired. As each graft develops others are inserted until none of the original foliage remains.

On level ground the stocks are planted in rows 12 to 20 metres apart. It is most important to give each tree plenty of space. The trees must be thinned out if they encroach on each other. On poor ground such as steep and rocky slopes where no other cultivation is possible they may be as near together as 7 metres. Erosion is prevented by terracing the slopes and constructing revetments.

In other places it is most important to keep the soil well aerated by ploughing. On the advent of the first rains in autumn the olive groves are thoroughly ploughed and again in the spring, *in the opposite direction*. The furrows should never be taken nearer than two metres from the base of a tree to avoid any risk of amputating the small roots. On sloping ground the furrows are made along the contours to catch and retain water.

Where the space between the trees is sufficiently great and the soil fertile, field crops may be grown but not on poor dry ground or in thick plantations where the soil cannot support both crops and trees. At Patras, on the mainland, I noticed raisin vines growing between olive trees, which were widely spaced. Count Sordina recommends potatoes and fodder crops such as beans, lupins, vetch, or even a little barley. Cereals rapidly exhaust the soil and should never be planted without legumes.

Skilful pruning can enormously increase the yield of fruit but when badly done the result is disastrous. The two principal objects of pruning are first, to give the boughs the maximum amount of air and light and second, to give them generally a downward direction. The latter is important since branches with an upward trend do not bear fruit but exhaust the tree. Hence they are termed "greedy." Moreover the lower the fruiting branches the easier it is to gather the fruit. It is also a good thing if the branches can be a little twisted which makes them more

fruitful. Bearing all this in mind pruning is begun on the young stocks when they are about three or four years old. The tops of the trees are cut at a height of four and a half feet from the ground in the month of January or, if the weather is then very cold, at the beginning of February. All the lower buds or "eyes" as well as some of the lower branches are then removed with a sharp knife. The upper buds are allowed to grow in spring. The upright branches developed from them will form the "skeleton" of the tree. Some of these are removed from time to time particularly those which begin to spread, care being taken not to weaken the tree. The object of this preliminary pruning is to give the crown a spherical shape thus affording all the branches the maximum amount of air and light. Not more than two shoots should be left on each branch.

As the tree grows all dead and diseased branches are immediately removed. The top branches are cut back to prevent excessive height growth which would make it difficult to collect the fruit. All "greedy" branches and superfluous ones in the centre of the crown which are not getting enough light are cut away leaving only those which are slightly twisted and having a downward direction. Pruning can easily be overdone especially when old and neglected trees are to be taken in hand. The Greek peasant is very apt to prune ruthlessly in order to get a regular shape as quickly as possible with the result that the tree is permanently injured. Pruning should always be gradual and "greedy" branches left if there are not sufficient of the other kinds to sustain the tree. Pruning is done in the harvest year which occurs every two years. The best instrument to use is a sharp axe or bill-hook. The large branches are sometimes sawn off and the cut smoothed with a sharp knife. Branches must be cut off close to the main stem to facilitate occlusion of the wounds. Tar is applied to the cut surfaces if pruning is done very early in the season, *e.g.*, after the first rains in the autumn but such early pruning is never done in localities visited by a severe winter. The cuts are always made to slope outwards.

Manuring is essential if the heavily pruned trees are to be kept in a healthy condition. The droppings of sheep and goats

are the best manure and a good custom is to enclose the animals for the night in pens under the trees provided they are not allowed to stay several nights under the same tree. When they have gone the dung is dug into the soil. Olive stones and refuse of oil presses also make good manure. Count Sordina is a strong advocate of chemical manures which are especially prepared in the University of Athens by the Royal Agricultural Society. Manuring should be followed by sowing vetch with a little barley or beans and lupins.

In very dry places the olive groves are watered in summer, or irrigated by constructing open ditches.

The Greek peasant is generally very careless in gathering the fruit. Every year much of it is destroyed or wasted. This is partly due to the neglect of scientific pruning, the trees being too tall or straggling. It is necessary to go to Italy, Algeria or the south of France to see the most economical methods of gathering the fruit and converting it into oil. In Greece a large proportion of the fruit is scattered by gales and stolen by passers-by. Count Sordina strongly condemns the local habit of knocking the fruit off the branches which damages both trees and fruit. He informed me that in Dalmatia the gathering is done with the aid of wooden combs affixed to the ends of long poles, but having tried this on his own estate he came to the conclusion that the damage done by these instruments is considerable. He believes in allowing the workmen to climb into the branches in the case of low trees and collect the fruit in small bags. With higher trees a light ladder is used. The fruit must be picked off cleanly with the hand so as to cause as little damage as possible to the branches.

There is not space to deal at length with the illnesses to which the olive is heir. Very hot or very cold winds do much damage. The groves are protected against them by shelter belts of cypress. Fungoid and insect attacks which are very numerous have been studied in great detail by Count Sordina both in the laboratory and in the field and effective remedial measures have been devised for most.

Greece is not the best locality in which to study methods of expressing the oil or preserving the fruit, those employed being

usually antiquated and wasteful. Speed and cleanliness are essential as the natural oil deteriorates rapidly on exposure to air. This is where the Greek fails. Owing to the scarcity of presses he has to store his fruit for a long time and generally does it in damp store rooms on his own homestead. The fruit is piled up in heaps on the floor or kept in leather bottles, both methods being very unsuitable. Count Sordina recommends storing the fruit in layers not thicker than 50 centimetres on a floor of brick covered with cement in dry and well aired store-rooms. Where such a method is not possible the fruit may be immersed in brine. Brine is also used for bottling olives for eating. The fruit is picked while green, *soaked for a few hours in an alkaline ley and then washed well in* clean water before being placed in jars or bottles filled with brine. Spices are sometimes added to flavour the preserved olives.

Count Sordina is of the opinion that olives could be successfully cultivated in North-West India. A species of wild olive (*Olea cuspidata*) grows on the southern slopes of the Himalayas and most of the Mediterranean varieties could be grafted on this without much difficulty. There ought to be a very large demand for the oil in India and there seems no reason why groves should not be successful on some of the dry limestone hills in the Punjab and N.-W. Frontier Province not reached by the south-west monsoon. Baluchistan would also appear to be a likely ground.

The home of the olive was originally in the dry hot climates of Western Asia. It has been successfully cultivated in such far distant places as California, Australia, South Africa, Chili and China.

The difficulty is not so much in propagating as in tending and for this, as I have attempted to show, a very high degree of skill is required. If it is proposed to continue seriously the cultivation of olives in India a thorough knowledge of the working methods of the Mediterranean countries especially Italy and the south of France, is essential.

If any Indian Forester or agriculturist would like to follow in my footsteps I shall be very glad to give him an introduction to

Count Sordina who is an excellent guide not only to the scientific study of agriculture but to all the natural beauties and archæological treasures of his native land. He is a true Greek patriot whose chief desire is to put his country right with the allies, especially Englishmen, and to give them a correct understanding of the problems of present-day Greece, her thoughts, aspirations and ambitions, so that they may help her to recover her ancient glories.

F. K. MAKINS, I.F.S.

[The Forest Department has an olive plantation in the Punjab at Khairimurat, Rawalpindi Division. It consists of 10,000 grafted trees and a dozen or so imported, but at the present time its abandonment is contemplated on the score of the climate being unfavourable to the regular production of fruit (frequent shortage of rains in the spring). A plantation in the Jhelum Division was given up some years ago owing to water difficulties but there are plantations in Kashmir and at Peshawar.

It may be added that recent tests at the Research Institute have shown that wild olive wood is specially suitable for tool handles.—HON. ED.]

DEVELOPMENT OF BAMBOOS FROM NATURAL SEEDLINGS (*DENDROCALAMUS STRICTUS*).

In 1911 Professor Troup started a very interesting experiment at Kotdwara in the Lansdowne Division of the United Provinces with the object of tracing the development of *Dendrocalamus strictus* natural seedlings up to their exploitable age and at the same time to watch the effect of protection from grazing on these bamboo seedling areas. Extracts from the earlier stages of the experiment were included in Professor Troup's " Silviculture of Indian Trees " but as the experiment was only half finished when the book was written this note has been written up with the object of enlarging on Professor Troup's observations now that full data are available up to the final stages of the experiment, *i.e.*, the exploitable age of the bamboos.

1911.—Two plots each about ¼ acre in size were laid out on 1st March 1911 on flat ground in open deciduous forest which was known to be heavily grazed. The plots were fenced with barbed wire and thus closed to grazing. The bamboo clumps already existing had recently seeded and the ground was covered

with young seedlings of about one year old, both inside and outside the plots. The object of the experiment was to observe the development of these natural seedlings inside the plot as compared with those outside the plot and therefore subjected to grazing, and at the same time to note carefully the rate of growth of the seedlings and to observe the method by which they formed clumps and the period which was necessary to form clumps of an exploitable size.

1912.—Observations were made annually and in January 1912 there was already a most striking difference between the grazed and protected areas. Outside the plots the ground was grazed nearly bare and bamboo seedlings were sparse and small. Inside the plots there was a thick growth of grass through which bamboo seedlings were coming up everywhere and varying between 18 inches and 2′ 6″ in height with a few up to 4′ where they were growing inside the old clumps. Considerable damage was done by pigs this year and hundreds of young bamboos were rooted right out of the ground.

A few sal seedlings also were observed to be coming up well among the bamboos at this time and had reached a height of about 1 foot in January 1912. They were probably from 1910 seed. Besides the above there was a mass of weeds and young *Millettia auriculata* climbers. The difference between the protected plots and the forest outside which was open to grazing was most striking.

1913.—In January 1913 the plots were covered with a dense growth of young bamboos from 2′ to 4′ 6″ high, most of them thin and whippy with wiry stems. A few of the large ones had culms ¼″ in diameter at the base and were fairly stiff and bamboo like. The old bamboo clumps were falling and there was a dense undergrowth of *Cassia Tora* and small *Helicteres Isora*, several young *Kydia calycina*, Sal and other species, and *Millettia auriculata* was rampant everywhere over the old clumps. Outside the plot there was a thick growth of *Cassia Tora* and in spite of heavy grazing young bamboos were to be seen everywhere. The recuperative powers of young bamboo seedlings was strikingly

demonstrated this year on the ground outside the plots. In 1912 the ground looked as if not a single seedling would survive the grazing but in 1913 numerous seedlings still persisted. They were badly grazed down and seldom even 1 foot high but they were still alive and plentiful. Where sheltered by the old dead bamboo clumps or bushes they were larger. The whole of this block of forest was fenced against grazing about this time, and the effect of this was most instructive. It is interesting to note that if the fencing had been done two years back there would have been a dense mass of young bamboos probably 3—4 feet in height instead of badly grazed seedlings barely 1 foot high, but it will be seen that this bad start had little or no effect on their subsequent development.

1914.—At the beginning of 1914 the bamboo seedlings inside the experimental plots had reached an average height of about 4 ft. with a maximum of 8 ft. in some cases. They were very dense but still rather whippy with thin wirelike stems although a 1½ inch diameter stem was occasionally to be seen. These were in most cases new culms which had sprung from the rhizome of the original seedlings. The damage which had been done by pigs in these plots in 1912 was hardly noticeable in 1914. The sal seedlings of 1910 were seen to be growing well and had reached a height of about 2′ 6″ and besides these several younger sal seedlings (probably 1912 seed) were observed to be established under the young bamboos.

With regard to the forest outside the plots there was really very little difference to be seen and the recuperative powers of young bamboos and the extraordinary vitality of the rhizomes was again brought strikingly to the notice of the observer. There was a dense mass of bamboo seedlings everywhere and if the fact had not been recorded no one would have suspected that the ground had been heavily grazed only two years previously.

These seedlings averaged about 3 ft. 6 ins. in height and some up to 6 ft. high were observed but except for this slight difference in height growth they were every bit as good as those in the plots.

1915.—By January 1915 the tallest bamboos had attained a height of 17 ft. but the average was about 7 ft. Some stems of 2·8 inches in diameter were measured but the average was only about 1 inch.

The tallest culm measured, *i.e.*, that of 17 ft. was in reality a new culm which had sprung from the rhizome of a young natural seedling, and was not one of the original seedlings and in fact practically all the large culms were new culms, the seedlings still remaining wiry and grass like and averaging only about 5 ft. in height.

1916.—By the beginning of 1916 the bamboos had begun to form into clumps. These were irregularly scattered over the area and about 7 to 10 ft. apart from one another. The average number of culms per clump was 3 to 5 and the height of the culms was 20—25 ft. with an average girth of about 3 inches. The original seedlings were observed to be gradually dying back and in no case were they seen to be growing up with the new culms. It can be concluded from this that the original seedling's life work is merely to form sufficient rhizome for new culms to spring from and having performed that duty it ceases to develop and is obliterated by the newer and stronger culms.

1917.—By November 1917 there was a dense mass of small clumps averaging 5 culms to a clump with an average mean height of about 16 ft.

From this point the two plots will be shown separately as their rate of growth and development were rather different.

Plot. I.	Plot. II.
Mean height 15 ft.	Mean height 18 ft.
Best clump—height 24 ft., diam. of culms 1·4 in. 7 new culms, 17 old culms.	*Best clump*—height 26 ft., mean diam. of culms 1·2 in. 6 new culms., 15 old culms.
Total culms 24.	Total culms 21.
March 1919.—Average number of new culms per clump, 6.	Average number of new culms per clump, 7.

Best clump.—
27 culms. Average height 26 ft. and average breast girth 4·5 inches.

Best clump.—
31 culms. Average height 26 ft. and average breast girth of culms 3·5 inches.

There was no undergrowth in the plots at this period and the sal seedlings which were looking so healthy a few years back had quite disappeared, killed back by the more vigorous bamboos.

The formation of clumps was observed to be developing very slowly.

December 1920.—Average number of new culms per clump, 1.

Best clump.—
33 culms. Maximum height 34 ft. with breast girth of 6 in.

Average number of new culms per clump, 1.

Best clump.—
39 culms. Maximum height 36 ft. with breast girth of 4 in.

The absence of new culms was due to the abnormal scarcity of rain in 1920.

Plot I.

March 1922.—Only 2 new culms produced in the whole plot and practically all the old culms are still whippy. This was due to too much overhead shade. The plot was very dark and shady.

Plot II.

Exploitable clumps formed.—An average of about 4 new culms per clump with a maximum height of 40 ft., minimum height 24 ft. Girth at breast height from 2 in. to 5·5 in.

Leaving out Plot I which was subjected to far too much overhead shade the fact was established that it had taken exactly 11 years for these natural seedling bamboos to form clumps of exploitable size. Professor Troup estimated that this species would take 12 or 13 years to reach this stage but these natural clumps, even after the very great shortage of rain in 1920, which affected them considerably, reached an exploitable size in 11 years without attention of any sort beyond protection from grazing. They are now ready for thinning in order to remove the congestion and accelerate the growth of new culms. The largest culms have attained a height of 40 ft. with a girth of 5·5 inches and with proper treatment these clumps should continue to increase in size

and productiveness for many years to come. With regard to the bamboos outside the plots these are to all intents and purposes the same as those inside and the hardships they endured for the first two years of their life seems to have had very little effect. This is probably due to the fact that although the seedling itself was grazed down the rhizomes continued to develop and when the new culms were formed in the 3rd or 4th year there was probably very little to choose between the rhizomes of the grazed and ungrazed plants. If the area outside the plots had been left open to grazing after the first two years there would probably have been a very different story to tell. The experiment was an interesting and instructive one from start to finish and as a result of the accurate observations made the information which it gives is both useful and reliable.

H. TROTTER, I.F.S.

NOTES ON SHOOTING AND FISHING IN THE SINGHBHUM FOREST DIVISION, BIHAR AND ORISSA, 1921 & 1922.

Bison.—Although rarely seen, bison are plentiful in most districts, wherever there is sufficient supply of water.

Cows are exceedingly scarce: out of some 30 bison seen in the two years, only six were cows, and one calf only was seen, and I got the impression that there are too many bulls for the numbers of cows.

I think the fine for shooting cows should be increased, with confiscation of head: and to prevent the possibilities of mistakes by beginners, it might be well to add a note to licences issued, suggesting that bulls with herds be left alone, and solitary bulls alone to be shot.

Sambhar.—The natives allege there are two distinct species of sambhar: the large type, of the usual reddish colour, hinds of lighter shade; the stags having manes and fine, rough horns.

The second species is black or blackish-brown, stags and hinds alike: the stags have little or no manes, and smaller, more curved and smoother horns.

I have seen both sorts, which the natives allege never interbreed, and out of some eighty or hundred sambhar seen, I have never seen both sorts together.

I shot one stag of the smaller variety, but did not get a shot at any head good enough of the larger variety, though I saw several.

In Best's book, *Shikar Notes for Novices*, mention is made of the alleged habit of sambhar swinging themselves by their horns (page 93). I have twice found traces of this, one quite unmistakable, as the animal's fore-hoofs while swinging had cut into an ant-heap, some 3 feet above the ground. From the time of year (April) it seems more likely that he was trying to loosen his horns preparatory to shedding them, rather than clearing them.

Chital—in the forest are very scarce, and good heads are rare: they seem, however, to be breeding well, a large number of fawns being seen.

Tiger.—I should think tiger are more common, but harder to get in the Singhbhum Division, than almost anywhere else.

Owing to density of jungle, and scarcity of population, beating for the ordinary sportsman is usually impracticable.

I found an excellent rule for tying up kills is to tie up always on a road. The cattle killing tiger is accustomed to finding his kills on or near roads and seems to look with suspicion on a cow tied up in dense jungle.

The hints given in *Shikar Notes* are invaluable and of help to every one, however experienced.

In the *Field* about a year ago a short correspondence took place on the subject of native shikaris' beliefs, and it was stated that the general belief held was that if the kill be found lying on its left side the tiger will not return.

I enquired about this and found that the local Hos also held this belief: further I have found it invariably borne out by fact, without a single exception.

In no case, where the kill has been found lying on its left side, has the tiger returned, though on one occasion such a kill was removed and eaten by another tiger some five days later.

Further, I found that if a kill be dragged some 200 or 300 yards, carefully hidden near water, and with preferably only the head eaten, the tiger nearly always comes back the same evening, usually by daylight.

From this it will be seen that the ideal place to tie up is on a road, preferably cross roads, not far from a stream, and one frequented by cattle.

I tried walking up tigers in the heat of the day, but although I saw three and heard four more, I never got a shot, the tigers being too quick and jungle too dense.

One of the tigers seen was a freak, of red and black colouring only, no white, and my shikari said he had seen a similar one not many miles away, a few years previously.

Bears—are common everywhere, though not often seen.

Panthers—seem scarce except near civilisation : I saw only one, which crossed a road in front of me some 300 yards away.

Hyænas—common round the jungle outskirts, apparently do not exist in the denser jungle, nor do jackals.

Elephants—appear to be far more numerous this year than last, and have done an immense amount of damage to the villagers' crops and to the forests.

From the point of view of the villagers, a certain number of the bulls should be shot. The cow elephants can be scared off the crops, but the bull elephants usually attack anyone attempting to frighten them away.

As Keddahs are not held in these districts, the loss of the bulls shot would harm no one and do a lot of good to the inhabitants, while provided the females are protected there would be no risk of the elephants becoming unduly scarce.

The elephants of these parts are mostly of the thick set, stocky type, and a bull of over 9 feet in height would be, I think, rare.

They appear to stick to certain well defined ridges and nullahs, which they leave only occasionally: quite a large number also seem to migrate from Porahat to the south and back again at certain seasons.

It is the bulls which live permanently in Singhbhum and not the migrating ones which seem to do the most harm : one of the chief localities for these animals is along the line of country Jeraikela—Tirilposi, parallel to the Bonai border, down to Nuagaon, and occasionally down the Koina valley, later in the season : this year the first elephant went down the Koina about the middle of April, after which they traversed it fairly regularly.

Pigs—are very numerous everywhere and appear to be on the increase : I saw one herd of some 20 to 30 near Tholkobad. A reduction in their numbers near villages would be much appreciated by the inhabitants.

Barking deer, Mouse deer and four horned antelope.

Barking deer are common everywhere, and it would be a great convenience to those shooting in the hot weather, if the males of this species could be shot "for the pot." During the close season for birds, it is often most difficult to get meat.

The mouse deer and four horned antelope are rather uncommon, but are so rarely seen that any special protection seems unnecessary.

Birds.—The *red jungle fowl* are common everywhere and breed earlier than the other birds : I saw young chicks early in April and the young birds are nearly full grown by the end of June.

The *Spur fowl* breeds much later, I have seen one week old chicks nearly at the end of June. *Peafowl* chickens first appear about middle of May.

I would suggest again that the cock birds of both red jungle fowl and peafowl should be allowed to be shot for the pot throughout the year ; this should not make any difference in their numbers, provided beating or driving for birds be prohibited during the close season.

A few quail breed in the jungle : I saw a nest with 5 young ones in May.

General.—Crocodiles up to 6 feet (Muggers, not garial) are common in the rivers ; so are *otters.*

I found the remains of one pangolin (scaly ant-eater) but they are rare. I never saw a live one.

I got several species of *snakes* but so far have not had opportunity of identifying them.

Red dog—are fortunately uncommon: I saw 3 in 1921, but a pack came into the Rangangora valley about May 25th this year and disturbed the game a good deal.

II.—FISHING.

1. In 1921, I had no idea of what kind of rivers existed, and came prepared for much heavier fish than I found; I caught some half dozen small fish only, mostly on the dry fly. This year I came prepared for both.

The late G. M. Cooper told me that there were supposed to be mahseer, but that no one knew for certain, and no one had met with much success fishing.

2. *Rivers.*—The following rivers were tried :—

(*a*) Koina, from near the head waters down to Manharpur.

(*b*) Rangungara, from Tholkobad to near Bonai border.

(*c*) Samtha, near Hendekuli.

(*d*) Bisruli, near Ponga.

3. *Species of fish.*—The following species of fish were actually caught (or seen, only where so stated):—

(*i*) Mahseer; caught up to 1½ lbs., seen up to about 3—4 lbs.

(*ii*) Carnatic carp; caught up to ½ lb., seen up to about 3 lbs.

(*iii*) *Barilius Bola* (one specimen only, in Rangungara).

(*iv*) Murral (*O. Striatus*) caught up to 8 lbs. (shot); seen up to about 15 lbs.

(*v*) Black Spot (*Barbus malecola*), common everywhere.

(*vi*) Indian fresh water perch (*Ambassis nama*), common everywhere. Very small.

(*vii*) A fish like a Baril, but with black lateral line, a sporting fish running up to about 2 lbs. I cannot identify this fish, and only caught small ones up to about ½ lb.

(*viii*) Garfish (*Belone carcila*), seen only, fairly common, up to 18 inches or 2 feet in length.

(*ix*) Chilwa ; rather scarce.

(*x*) Thorn backed Eel ; common, up to 2—3 lbs.

(*xi*) A Carp ; unidentified, very like Carnatic Carp, but with black mark behind gills.

(*xii*) Batchwa (3 caught in lower Koina only).

(*xiii*) Tengra ; up to 1 lb. only.

(*xiv*) A fish up to about 1 lb. 3 lateral stripes. Feeds on weeds and takes no bait. Seen only, not identified.

(*xv*) *Barilius Barila* ; upper Koina only.

4. *Baits and Methods.*—Baits were used as follows :—

(*i*) *Fly.*—Poor success, chiefly in Bisrub river. Best fish on fly, Carnatic Carp ½ lb. Dry fly, red or reddish brown seems to take best. Black flies, so universal in India as a rule, seem useless in these rivers.

(*ii*) *Atta.*—Met with no success whatever.

(*iii*) *Fly-spoon.*—Caught two small fish only. The Mahseer, Perch, fish described in 3 (*vii*), and Garfish would follow the spoon to one's feet, time after time, but never take it: this, I think, is chiefly due to clearness of water and lack of stream.

(*iv*) *Worm*—(bottom fishing) ; successful for small fish.

(*v*) *Upstream worm.*—By far most successful on the whole, and most amusing.

Use a very small hook, sizes 0 to 2 are best. Bait with head of worm only, and cast like a wet fly, up or across stream (upstream is best where practicable). Strike at slightest stoppage of line, using of course very fine gut. Fishing down stream this way, one misses a lot of fish.

The head of runs is the best place; still pools and tail of runs not much use as a rule.

Ten Mahseer, up to 1½ lbs. were caught by this method, and many small fish, including all the Barils caught.

In 3 cases, large Eels seized the small fish while being played and one was nearly netted, before it let go. Total number of fish caught 261, mostly very small.

5. *General notes.*—Fish, particularly Murral run up very high to spawn in the rain. In early April I found a number of Murral fry in some liquid mud, on the 2,000 foot contour of Ligirda Buru, 600 feet above the river, only 1½ miles away. Similarly the very small pools and patches of mud, in the highest and driest jungles are usually full of small fish.

The more remote rivers, Koina, etc., are little fished by the natives, but all, within easy reach, are heavily poached, chiefly by driving the small pools with sticks.

6. *Conclusions.*—The rivers generally before the rains suffer from lack of water, and it is difficult to catch decent sized fish for this reason.

The Koina and Rangungara, in particular, should give first rate sport, when they clear after the rains, and while there is plenty of water in them.

The Samtha river I only fished once, going to Hendekuli and back in the day from Tholkobad; there appear to be a lot of Carnatic Carp in this river, which looks more hopeful for the fly than most: spoon should be more successful everywhere with more water.

O. B. FOSTER, MAJOR,

June 1922. *5th Fusiliers.*

FURTHER REPORT ON TESTS OF HAMMER HANDLES MADE OF INDIAN WOODS.

In the *Indian Forester* of April 1922 was published a report of some tests carried out at the Forest Research Institute, Dehra Dun, on hammer handles made of Indian Woods. Further tests have now been completed and the results presented in this note.

As in the case of the earlier work, since the enquiry relates only to the use of the material for tool handles, only bending tests have been employed. In the "Static Bending Test" the load is applied slowly, at such a machine speed as will cause a strain of 0·0015 inches per inch per minute in the extreme fibre. In the "Impact Bending Test" the specimen is broken by allowing a 50 lb. weight to fall on it. The former series of tests were made in an Olsen Universal Testing Machine, and the latter in a Hatt-Turner Impact Testing Machine. These methods of testing are standard, and the results therefore comparable with all investigations conducted under standard methods.

Immediately after each test a disk was cut from the handle to use in determining the moisture content of the wood.

Table No. 1 presents the results of these tests, and Table No. 2 shows the corresponding values for wood containing 12 per cent. of moisture. This latter table is presented for the purpose of comparing these woods with those formerly tested, which contained 12 per cent. moisture, because strength comparisons are misleading unless based on wood of the same moisture content.

In Table No. 3 the strength characteristics are presented as in the case of the former report, as percentages of the corresponding values for *Olea ferruginea.*

The results in Table No. 1 show what strengths may be expected of these woods in this part of the country towards the end of the dry season, that is to say when the conditions are such as cause the wood to have an average moisture content of about 7 to 9 per cent. of the weight of the dry wood.

Table No. 2 shows the corresponding computed strengths of the same woods when a moisture content of 12 per cent. is present. The values for *Terminalia tomentosa* in this table are in reasonably close agreement with those found in the former tests and published in the *Indian Forester* of April last, though in both cases the number of tests was small.

On Table No. 3 is based the general conclusions as to the suitability of these woods for handles, assuming that *Olea ferruginea* may be considered a satisfactory handle wood. Table No. 3 shows that these two species, under gradually applied strains, are from 30 per cent. to 64 per cent. stronger at elastic limit and 14 per cent. to 29 per cent. weaker at maximum load (columns 1 and 2). In common language this means that if bent slowly they will resist a greater bending force without showing the first signs of breaking, but, once they start, they will break off completely, more easily than *Olea ferruginea*. In the same way we see from column 3 that these woods are not so stiff as, and from column 4 that they are from 2·78 to 4·3 times as tough as *Olea ferruginea* under a gradually applied strain as, for example, when a man tries to split wood by twisting the handle of the axe sideways after having imbedded the tool in the wood.

Considering next the effect of a blow, both species, except in the case of shisham sapwood, are practically the same as *Olea ferruginea* up to the first signs of failure (column 5), are considerably less stiff (column 6), and require appreciably more force to produce a complete fracture.

From these tests then it would appear that the sapwood of *Dalbergia Sissoo* is unsuitable for handles, but that the heartwood of this species, and both the heartwood and sapwood of *Terminalia tomentosa* should make good tool handles.

This special investigation has of necessity been restricted to a very small number of tests. Of much more value, in this connection, will be the results of tests being made according to routine methods known in this Institute as Project No. 1. These not only comprise a large number of tests with correspondingly reliable averages, but, being conducted on strictly standard lines, will

give a direct comparison with such woods as American Hickory, and will thus establish definitely the place of Indian-made in competition with imported handles. *Terminalia tomentosa* is now being tested under Project No. 1, and when complete the results will be made public.

L. N. SEAMAN,
OFFICER IN CHARGE,
Timber Testing Section,
Forest Research Institute.

TABLE NO. 1.

Species.	% Sap Wood.	Moisture % of Weight of Dry Wood.	Static Bending. Fibre Stress at Elastic Limit. Pounds per sq. in.	Static Bending. Modulus of Rupture. Pounds per sq. in.	% Sap Wood.	Moisture % of Weight of Dry Wood.	Impact Bending. Fibre Stress at Elastic Limit. Pounds per sq. in.	Impact Bending. Height of Drop of 50 lb. Weight causing Failure.	Remarks.
Terminalia tomentosa.	*Nil*	7·9	16,590	22,100	*Nil*	7·4	41,990	8·42 ins.	As Tested.
" ...	100	7·2	15,400	19,310	100	8·7	40,810	9·75 "	"
Dalbergia Sissoo	*Nil*	6·9	14,370	21,400	*Nil*	9·1	41,720	11·75 "	"
" ...	40	6·8	16,630	22,120	40	7·8	32,720	6·75 "	"

TABLE NO. 2.

Terminalia tomentosa.	*Nil*	12	12,510	18,470	*Nil*	12	34,270	9·58 ins.	Computed from Table No. 1.
" ...	100	12	10,960	15,600	100	12	35,420	10·72 "	"
Dalbergia Sissoo	*Nil*	12	9,960	17,030	*Nil*	12	36,880	12·77 "	"
" ...	40	12	11,440	17,520	40	12	27,220	7·60 "	"

TABLE NO. 3.

Static Bending.				Impact Bending.			Species.
1	2	3	4	5	6	7	
Fibre Stress at Elastic Limit.	Modulus of Rupture.	Modulus of Elasticity.	Work to Elastic Limit.	Fibre Stress at Elastic Limit.	Modulus of Elasticity.	Ins. drop causing complete failure.	
142	71	58	380	102	78	115	*Terminalia tomentosa* (100 % Sapwood).
164	86	66	430	99	87	103	*Terminalia tomentoso* (100 % Heartwood).
130	80	70	278	106	80	137	*Dalbergia Sissoo* (100 % Heartwood).
143	80	73	354	81	67	82	*Dalbergia Sissoo* (40 % Sapwood).
100	100	100	100	100	100	100	*Olea ferruginea.*

Moisture content. 12 %.

SURVEYS OF FOREST RESOURCES.

An inventory of our forest resources is acknowledged by all to be essential to the full development and use of the forest estate.

This subject was discussed at considerable length at the meeting of the Board of Forestry in 1919 but the results have so far not come into prominence. A subscriber asks whether we have any information about forest valuations or surveys of forest resources, which are being carried on in different provinces, and the methods by which and objects with which they are being made.

The reply is that we know of a few instances in which valuation surveys have been carried out with specific projects but we are unaware of the general policy that may be in actual progress. It would therefore be of interest, at this stage, to collect such information as is available and to abstract it for the benefit of Indian forestry as a whole. We therefore invite all who are engaged or interested in this subject to afford us the means of helping others.

THE MADRAS FOREST COLLEGE JUNE WEEK.

On the 28th of June last, the Madras Forest College exhibited in the local Cinema an interesting and instructive series of films of up-to-date lumbering operations in Amer ca, and a few slides representing similar work as it is now being done in the Government forests at Dhoni in South Malabar. This exhibition formed a special feature of this year's programme among the usual attractions of the "Forest Week." A big audience including many members of the Legislative Council, of the Forest Advisory Committee, and other public men as well as Forest Officers, Government officials and a large number of the general public were present.

Mr. C. S. Martin, Chief Forest Engineer, whose services have recently been secured by the Madras Government, explained

the films in a very lucid manner, demonstrating, in particular, the superiority of the "Clyde Catterpillar Tractor" to the present slow, and wasteful method of using buffaloes, etc., for dragging timber. The "Variety Hall" was, in a most public spirited manner lent for the occasion by the Proprietor Mr. S. Vincent.

The Annual Engineering Park Demonstration took place on June the 29th; when the students under Messrs. Robinson and Hart gave some interesting displays of bridge building, brick laying, tramline laying, and erection of derricks, sheers, etc.

On the 30th of June which was the concluding day of the "Forest Week," an unusually large and distinguished gathering of officials, and non-official Europeans and Indians assembled in the recently enlarged hall in the Madras Forest College to witness the distribution of certificates, medals, and prizes to the ninth batch of successful students. His Excellency the Governor presided, while Her Excellency Lady Willingdon did the College and Students the honour of distributing the Prizes and Certificates.

Prominent among those present were:—

The Hon'ble the Raja P. Ramarayaningar, the Hon'ble Dewan Bahadur K. Venkata Reddi Naidu, Ministers for Local Self-Government, and Development, respectively; Mr. Cox, C.I.E., I.F.S., Chief Conservator of Forests, Madras, and Mrs. Cox; Mr. W. F. Perrée, C.I.E., I.F.S., Chief Conservator of Forests and President of the Imperial Forest Research Institute and College, Dehra Dun, and Mrs. Perrée; the six Conservators of Forests of the Madras Presidency; H. C. Sampson, Esq., C.I.E., Director of Agriculture; H. L. Braidwood, Esq., I.C.S., Collector of Coimbatore; C. S. Martin, Esq.; M. R. Ry. Dewan Bahadur T. A. Ramalingam Chettiar Avergal, B.A., B.L., M.L.C.; M. R. Ry. C. V. Venkatramana Ayyangar Avergal, M.L.C.; M. R. Ry. V. C. Vellingiri Goundar Avergal, M.L.C.; M. R. Ry. R. K. Shanmugham Chettiar Avergal, M.L.C.; M. R. Ry. Rai Bahadur Nallathambi Sarkarai Mandrariar, the Pattagar of Playakottai; M. R. Ry. Rao Sahib Rathnasabapathy Mudaliar Avergal and M. R. Ry. M. Sambandam Mudaliar Avergal, M.L.A.

Their Excellencies were met at the main entrance to the College by the Chief Conservator of Forests and the Principal. His Excellency then inspected the Guard of Honour formed by the students. After the Conservators of Forests and the staff of the College had been presented to Their Excellencies the party proceeded upstairs to the Prize Distribution Hall.

The prizes and awards are as follows :—

(1) The Campbell Walker Prize, for the student who is likely to make the best all-round Ranger, won by K Annappa Bhandary.

There were several others whose names came ıp for consideration and these were—

N. S. Poonacha,
P. Sithapathy Ayyar,
M. Mologoda,
V. Ramalingam.

(2) The Brasier Prize for the Student likely to make the best outdoor Ranger ; won by K. Annappa Bhandary again ; there were several others whose names came up for consideration and these were—

N. S. Poonacha,
M. Mologoda,
M. Mandanna,
M. B. Aiyanna,

(3) The Gold Medal for the best Senior Division Student on marks, presented by Government ; won by P. Sithapathy Ayyar.

(4) Silver Medals for Honours, presented by Government ; won by—

P. Sithapathy Ayyar,
A. K. Kunhunni Nair,
M. Mologoda,
V. Ramlingam,
K. Annappa Bhandary.

(5) The Madras Conservator's Prize for Forestry, won by P. Sithapathy Ayyar, and

(6) The Lodge Prize for Engineering, won by P. Sithapathy Ayyar.

(7) The Indian Forester Prize for an Essay by past students was awarded to Mr. T. D. Ponniah.

(8) The Indian Forester Prize for an Essay by present students. The subject was "Why did you choose Forestry as your profession."

Several good Essays were received. The prize was awarded to P. Sithapathy Ayyar.

(9) The Chief Conservator's Prize for the best student in the Junior year has been won by K. Shankaranarayana Rao of the VIth Circle, Madras.

(10) The Pentland Shield for the best all-round Athlete in the College, has been won by M. B. Ayyanna, from Coorg.

(11) The Fischer Challenge Cup for Gymnastics, has been won by S. C. Ramalingam of Ceylon.

(12) The Examination in First Aid to the Injured held this year as usual, resulted in 21 students out of 35 gaining certificates.

(13) The Madras Forest College certificates have been awarded as follows :—

Honours Certificates :—

1. P. Sithapathy Ayyar, who also obtained a 1st aid certificate.
2. A. K. Kunhunni Nair, who also obtained a 1st aid certificate.
3. M. Mologoda, who also obtained a 1st aid certificate.
4. V. Ramalingam, who also obtained a 1st aid certificate.
5. K. Annappa Bhandary, who also obtained a 1st aid certificate.

(14) *Higher Standard certificates*, in the following order :—

6. K. Seetharama Hebbar.
7. N. S. Poonacha, who also obtained a 1st aid certificate.
8. B. Kotilingam, who also obtained a 1st aid certificate.
9. M. S. Krishnaswami, who also obtained a 1st aid certificate.
10. G. V. Moghe, who also obtained a 1st aid certificate,

11. M. Mandanna.
12. Balak Ram Anand.
13. K. Gopalakrishna Rao, who also obtained a 1st aid certificate.
14. S. C. Ramalingam, who also obtained a 1st aid certificate.
15. J. K. Bodas, who also obtained a 1st aid certificate.
16. M. Ganesan.
17. P. A. Madhavan.
18. N. Rajagopalachetty, who also obtained a 1st aid certificate.
19. M. Abdul Hamid, who also obtained a 1st aid certificate.
20. G. A. Vagle, who also obtained a 1st aid certificate.

(15) *Lower standard certificates* in the following order :—

21. A. Thirupathy Rayadu, who also obtained a 1st aid certificate.
22. G. R. Kelkar, who also obtained a 1st aid certificate.
23. M. Warris Husain.
24. Balakrishna Das, who also obtained a 1st aid certificate.
25. A. Narayana Rao, who also obtained a 1st aid certificate.
26. Hans Raj Dutt.
27. H. Wijesinghe.
28. K. O. Anandan, who also obtained a 1st aid certificate.
29. L. S. Chati.
30. J. B. Rodrigues.
31. M. Hasnuddin Khan.
32. S. R. Punde.
33. M. B. Ayanna, who also obtained a 1st aid certificate.
34. D. A. Abeyaratne.
35. P. Gopalan.

Speeches were given by the Principal and by H. E. the Governor.

Under Utilisation it is interesting to note a short reference to the results of a light railway put down by Messrs. Steel Bros. While the railway proved successful, the tractor could not in the long run compete with buffaloes for dragging. It is to be feared that this will always be so until the designers and makers can produce a fool-proof machine suited to tropical conditions. The remarks by the Utilisation Conservator on the needs of an economic survey of the supplies of valuable timbers are very much to the point. The lack of any authoritative information as to the supplies in the forest is bound to hinder the development of a market for these timbers.

Another sign of better times ahead is the diminution in the tale of dismissals and resignations amongst the subordinate staff. It is to be hoped that improvements in housing will follow rapidly on the improvement in pay.

MINOR FOREST PRODUCTS OF THE MALAY PENINSULA.

BY F. W. FOXWORTHY.

This interesting descriptive list of the minor products of the Peninsula forms No. 2 of the series of Malayan Forest records.

The general treatment of the subject is that followed by A. Rodger in the Handbook of Forest Products of Burma which was recently reviewed in these pages, but as the list does not include timber, the writer has been able to deal in greater detail with the methods of collection and preparation of the produce, and other interesting accessory information.

The section dealing with Rattan is particularly worthy of the attention of those concerned in the cane trade, which probably suffers in India from lack of the care shown in the preparation of the cane in the Malay Peninsula.

For the purpose of ready reference the work would be greatly improved by the addition of an index of scientific names.

We hope that Dr. Foxworthy will be able at a later date to enlarge this work which offers such a wide field for further research.

As it is, it is a most useful contribution to the very scanty literature available in these widely used but little known products.

W. A. R.

TIMBER DRYING.

Mr. H. D. Tiemann, M.E., M.F., of the U. S. A. Forestry Department, recently gave a series of lectures in Melbourne at the invitation of the State Ministry. The following extracts from his first lecture are taken from the "Australian Forestry Journal" for December 1921.

Mr. Tiemann said he was not offering any panacea for the solution of all problems in respect to drying or seasoning timber. The best he could do was to give them the results of a little applied commonsense based on sixteen years' experimental work in handling and seasoning timber. In drying wood there existed three factors at the disposal of the person handling it. These were, circulation of medium, humidity and temperature. By the control of these, the man seasoning timber can bring about good or bad results. There was no mysterious process, and no need of a complicated system if the man had control of those factors. The policy of the U. S. A. Government is not to hide in secrecy anything known which may be of general benefit. They take what scientific knowledge they can get, and apply that knowledge. Referring to the need for forest preservation, the lecturer said that only about six years ago, the U. S. A. was exporting wood pulp, whereas at the present time it was importing two-thirds of the pulp wood required for its own use. Had their forests been under proper control soon enough, they would not now have been importing that pulp. There was enough forest country if planted, to provide for all their needs and for export.

The planting of forests is the best thing that can be done in the interests of future generations. Existing forests should

be protected in order that they are not further depleted: In the U. S. A. by fire; in Australia by fire and grazing.

Seasoning is a subject of conservation of resources. The terms so often used of "natural" and "artificial" seasoning are misnomers; there is no such thing as natural seasoning Nature's method is to destroy fallen timber. The only real difference is that one is a process of drying under intelligent control, and the other a process of drying by accident. All seasoning is unnatural. To take some of the oldest trees, they had been found to be wet in the inside of them after having lain for over 4,000 years. If a tree is cut down, and the timber opened out, and the water allowed to evaporate from it and the wood to shrink, that is not natural. In its natural state it is full of moisture.

"Kiln-drying" is another unfortunate term; it always prejudicially affects the mind. It is associated with lime burning and the baking of bricks. By kiln-drying, as usually meant, a chemical change is effected, which makes a result unlike the wood as it came from the tree. This has led to much misconception.

A much better term would be "conditioning" by aid of mechanical means.

The question of whether wood should be air or kiln-dried is often asked, but cannot be answered off hand. Air seasoning goes on without control of atmospheric conditions. If you can protect the timber against the sun and insects, and can afford the time, you cannot do better than air drying. But it takes years, and therefore perhaps a more rapid process may be necessary. A poor process of kiln-drying is most destructive, and has done an enormous amount of damage to timber.

Before the war, and during the war, the question first came before the Government in respect to gun blanks. In the ordinary way two and a half to three years was required, and there was no alternative but to resort to kiln-drying. The first attempts ruined 58 per cent. of the material. After careful study and establishing the water spray kiln, the loss was reduced to 1 per cent. This shows that losses have been enormous. The expense

may apparently be more in some cases than air drying, but many considerations call for careful calculation of the comparative cost of handling, interest on investment, rent of land and sheds as against interest on equipment, depreciation of timber, losses from checking, honeycombing, and insects under air drying, cost of operating kilns, steam, water, and attendance. The relative costs and losses must be known pretty closely before a comparison can be made, and they cannot be guessed at.

The depreciation by air seasoning is as much as 30 per cent. whereas in kiln drying it can be kept down to 2 per cent. The cost of operations is more or less proportionate to the length of time taken ; if only two weeks, it is only half as much as if the time taken be four weeks. In the U. S. A. the time varies from two weeks to six months.

" Douglas Conifer," which is known in Australia as " Oregon " is dried perfectly in twenty-four hours.

Eucalypts in the same kiln would be almost pulverised under the same conditions. The older the Eucalypt the better it evidently became.

White Oak takes as long as six months to condition, which, if air-dried, would take three to four years, and then never be properly seasoned owing to " checks. "

The size of timber dried by the kiln process is usually 4 inches thick by 6 inches to 4 inches wide. The question of whether the quality is detrimentally affected has been very thoroughly investigated at the Madison Laboratory. The U. S. A. Government had no option. It must have timber, and expense was not considered. It had to kiln-dry for war purposes, and therefore it applied commercially the ascertained successful methods.

The Signal Corps' laboratory undertook an exhaustive series of tests to determine whether there was any loss of quality. Over 1,30,000 tests were made. Over 130 kilns were run. The tests included air-dried and kiln-dried timbers under varying processes and conditions. The results of both systems were tested to determine the strength of the timber. This meant many intricate

investigations, and led to some surprising results. Thus it was found that a certain percentage of moisture in timber rendered the strength four times as great as when dry. It was proved that kiln-seasoned timber is in no wise inferior to air-dried.

The lecturer deplored the fact that some timber-sellers had made most prodigious and ridiculous statements respecting their products. Strength in timber involves stiffness, work impact, and height-of-dropping impact, hardness, and bearing stresses.

Mr. Tiemann said water is contained in timber in two conditions, one being free water, as in a sponge, or honey in a honeycomb, and the other being imbibed water contained in the cells. The hygroscopic moisture contained in wood caused the shrinkage and swell in timber. The lecturer explained the effects caused by drying timber too rapidly, and exhibited specimens of case-hardening and uneven drying both by air and kiln process. He explained the cause and effects of case-hardening, and the stresses and changes in the compression and tension stresses. Faults caused in drying remained more or less permanent defects. They occur in air drying, but to a greater extent in kiln drying. Collapse of the interior cell structure of timber often occurs in very moist timbers. Temperature and humidity require careful regulation, high humidity being necessary for rapid drying.

One of the advantages of kiln drying is that the required moisture in timber could be assured. If 7 per cent. moisture was necessary for the flooring to suit any given climate, an architect could specify his requirements, and be assured of getting them. Further, all vermin such as ants and borers were destroyed, and loss which occurred from such causes during air drying was eliminated.

He thought Australia should be self-supporting so far as timber requirements were concerned. Co-operation between the several Governments, and between manufacturers and the Government should be obtained. The Government could well carry on experimental work to endeavour to get the best utilisation of the State's timber resources in the right direction.

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FOREST FINANCE.

The correspondence which has recently taken place in the pages of the *Indian Forester* on the above subject illustrates in my opinion the danger to which practical forestry is periodically exposed of being brought into subjection to the theories of financial doctrinaires.

One gentleman whose knowledge of forestry has taught him the absurdity of applying in general practice the usual financial formulæ, thinks to attack the economists on their own ground and produces a formula of his own (which at first glance appears to be correct) to support in theory what he feels to be the correct practice. As might be expected he is promptly routed by the economists who have no difficulty in showing that his formula is based on entirely erroneous assumptions. So far so good; a good case is weakened by being supported by false arguments. But the impression left on my mind after reading the letters to which Mr. Bourne's original article has given rise is that the economists are out to prove that it is unsound forestry to invest money in a forest project, if the rate of

interest obtained appears, on the application of the accepted formulæ, to be less than the ordinary rate for Government borrowing, and that it is equally unsound to adopt any rotation other than that which, judged by the same standards, appears to yield the highest rate of interest. It is these contentions which I desire to dispute and will attempt to disprove.

In the first place, I would put forward the proposition that the amount of money which it is advisable to spend on replacing a forest which has been handed down to us by nature or by our predecessors, does not depend on the ratio of future yield to the amount of present costs plus compound interest at the time the future crop is realized, but on the ratio of present costs to present yield. To prove this I will give the following illustration; and in this and other illustrations it may be noted that the figures are not intended to be actuals, they are purely imaginary given for the purpose of illustration only.

Far away in the Himalayas we find a magnificent fir forest. Unfortunately it is so inaccessible that it cannot be exploited at a profit with our ordinary methods of working. A forest engineer, however, points out that clear felling will provide sufficient revenue to recover the capital cost of the necessary logging plant and give a profit of Rs. 600 per acre. The destruction of the forest without replacement, is held on all grounds to be inadmissable, but the forest officer is prepared to guarantee the replacement of the forest by planting at a cost not exceeding Rs. 400 per acre. (*N.B.*—Some silviculturists may say that a fir forest in the Himalayas cannot be replaced after clear-felling at any cost; this *may* be true but it does not affect the argument.) The transaction will, therefore, yield a profit of Rs. 200 per acre. The argument that we cannot afford to spend Rs. 400 per acre on the artificial regeneration of a fir forest, because the amount of this sum at a compound interest when the new crop is mature (over Rs. 20,000 in 100 years) will be much greater than the revenue we can hope to obtain from that crop, is obviously fallacious since it involves abandoning the utilisation of the forest and sacrificing Rs. 200 per acre now. Exactly

the same considerations will apply at the end of the next rotation, though the crop is now an artificial one. Moreover since the capital invested in the forest is nil, it is difficult to see how an imaginary rate of interest which we think we ought to obtain on an imaginary capital, can be the determining factor in deciding the length of the rotation to be adopted.

"That is all very well," you will say, "where you have a natural forest to start with, but surely, when a forest has to be created we must justify it, by calculating the final amount of the cost, as obtained by adding compound interest charges up to the end of the first rotation." If this final cost is to be set off against final values, calculated at the current rates of produce, then I entirely disagree. The fact which invalidates all calculations made in this manner, is that the ratio of the value of money (in which form we pay our costs) to the value of produce (in which form we recoup ourselves) is a constantly changing one, and, taken over a long series of years, shows a steady fall. Since the period which elapses between the incurring of the costs, and the reaping of the harvest, is, in forestry, generally a very long one, a forest investment is likely to turn out much more profitable than the original forecasts, if made in the conventional manner, indicated.

Again to illustrate my meaning let us consider the case of a forest officer who in the year 1500 A.D. sowed oak which he proposed to work on a 400 year rotation (*N.B.*—They still do this in parts of Germany) and paid his labour at the rate of one penny per diem; he might have received a considerable shock if a mathematical friend had pointed out to him the final cost of his crop, as compared with its value calculated at the then current price of oak timber, say, a half-penny per cubic foot. If the forest officer, however, had been able to foresee his successor selling the mature crop in the year 1900 A.D. at five shillings per cubic foot his consternation might have been lessened.

My conclusion, therefore, is, that in afforestation projects, the soundest method of appraising future financial prospects, is to look into the past. Instead of calculating the result at the end

of the rotation by assuming that the price of produce will remain as at present, it will be advisable, taking actual past figures, to ascertain how we should now stand, if we had done what we now propose, a rotation ago; moreover considering the nature of forest operations, we shall be well advised to make this calculation for several periods ending say 10, 20, 30......years back.

As regards the question of the rate of interest to be used in forest calculations, we must again look into the past, and, since afforestation projects can generally be postponed until circumstances are favourable, we shall be justified in taking the lowest rate of interest which has obtained for a considerable period on gilt-edged securities; in the British Isles this would not be more than 2½ per cent. It is questionable, however, whether even this rate of interest is low enough for adoption in forest projects. A short time ago, a now discredited financier, endeavoured to persuade the British Government to raise money by premium bonds. The idea was to appeal to the man who could not afford to risk his capital but was prepared to sacrifice interest for the sake of a possibility of drawing a big prize. The investor's capital was safe, he contented himself with, say, 2 per cent. interest in the hope of winning a big prize, provided by the interest sacrificed by himself and other investors. Now, forestry as an investment, somewhat resembles the premium bond system, though the appeal is hardly to the gambling instinct. If the interest on the money invested is at normal times low, the capital is comparatively safe and there is a prospect of a big prize as a result of a rise in prices; also there is the advantage that the realization of this prize is not entirely outside the control of the investor, in that, the produce for disposal in any one year is not an absolutely fixed quantity. Compare the cases of two persons, who in the early nineties invested equal sums in Consols and Plantations respectively. At that time Consols stood at well over par and paid little more than 2 per cent., and forest enthusiasts had difficulty in showing that forests could pay any more. About 1918, the investor in Consols sees his capital reduced to considerably less than half, whilst the investor in Plantations has

perhaps quadrupled his capital by selling off the produce in the form of pit-props.

It may be said, that such very exceptional circumstances, as the above are unlikely to occur again. I disagree. Disturbed times in our own or other countries, from which we import, are certain to recur, and in such times home-grown produce invariably obtains abnormal prices. The former can only prepare to take advantage of the circumstances after they have arrived, but the forest officer can anticipate them and his ability to postpone or advance his harvest makes his profit a certain one. The big investor appreciates the advantage he possesses over a small man, in his ability to spread his risks, and such an one should particularly appreciate an investment, which will give an abnormally high yield at times when the majority of his investments are non-productive. An estate-owner and a nation will, if they are wise, and if they have the necessary land and capital available, grow forest at least sufficient to provide for their own essential annual requirements. If, for a time, they are losing money by accepting a low rate of interest and by growing produce at a higher price than they can purchase it, this loss will be small compared with that which will fall on them at some time when they are compelled to purchase in a high market.

If money has actually to be borrowed, then the question has to be considered whether it can be repaid within a short time from other resources. Normally a man would be a fool to borrow money at 6 per cent. in order to invest it in Premium Bonds at 2 per cent. even with the possibility of a prize; but, if he has some money coming in shortly with which he can pay off the loan, and if the opportunity of buying the bonds is a temporary one, the position is altered. Likewise it is obvious that a forest estate must have an assured, though not necessarily an annual income, not less than the interest which has to be paid on the money borrowed to start it; but, if conditions make it a question of now or never, in a matter of afforestation, and if there will be large yields from existing forests after a short period from which the loan can be repaid, there may be no objection to a state borrowing at 6 per cent. or more for the project.

Mr. Bourne's contention, therefore, that governments are institutions which can afford to lend money for long periods at a low rate of interest, even though they may have to borrow temporarily at a much higher rate does not seem to me so ludicrously absurd as it does to two of his critics.

The considerations, which have been put forward above, seem to indicate that the calculation of the financial rotation in advance, even for afforestation projects, is subject to such uncertainties as to be of little value. In any case, the decision of the rotation, at the time of planting the crop, must be a tentative one, and before making a decision to commence his fellings, the owner will naturally take into consideration the current financial as well as silvicultural conditions; but a forest owner, who, in order to introduce the rotation giving apparently the highest income, seems to be indulging in a very hazardous speculation in future values. Such an alteration involves a transfer of capital, which cannot be completed in a moment and before the transfer is completed the conditions which appeared to justify it, may have altered entirely.

In conclusion I am unable to agree with your correspondent who says that all forest investments should be able to stand the usual test of financial soundness, since I suspect the nature of the test; in fact I am in the position of a protectionist arguing with a free trader or *vice versâ*.

Finally, I must apologise to readers of the *Indian Forester* for having ventured to write on the subject of Forest Finance, without introducing a single formula, and also for having occupied so much of your space with an unpopular subject.

M. R. K. JERRAM, I.F.S.

FOREST VILLAGES IN ASSAM.

Forest villages in Assam fall mainly into two categories, namely, those with settled paddy lands, which are cropped continuously, and those subsisting on hill-side jums. The latter are similar to the taungyas found in Burma but comparatively rare in the rest of India where the practice of nomadic cultivation has been discouraged.

Juming is the ordinary form of cultivation carried on by the hill tribes in Assam and has led to gradual disforestment, especially in the Garo Hills, where the period of fallow is, owing to pressure of population, so short that the coppice shoots are not strong enough to resist fires when the ground is cut over for burning. This disforestation does not, in the climate of Assam, lead to serious denudation, though no doubt the soil cap must be wearing thin on many a hill top. Immediately a jum is left, it is rapidly covered with long grass and *Eupatorium* (giant *Ageratum*) and seedlings of *Macaranga* and *Trema.*

Forest villages with permanent paddy lands are fairly common and the largest area in Assam lies round about Kochugaon in the Goalpara district where a strike took place during 1921-22 under the auspices of the non-cooperation movement.

FOREST VILLAGES AS A SOURCE OF LABOUR.

The maintenance of an adequate supply of local labour in forests situated some way from the railway and therefore away from external sources of labour is one of considerable difficulty.

In the Goalpara district of Assam, labour dependent on payment as a means of livelihood is practically unknown.

The reason for this is to be found in the climate and soil. The soil is fertile, rain copious and frequent, and drought unknown with the result that even in the leanest of years the cultivator is assured of enough to live on, while the sale of his surplus rice and a crop of jute or mustard provides him with enough money to purchase other necessities of life.

The cultivator is, therefore, under no economic necessity to work for the sake of payment, and being easy-going and indolent by nature, an ordinary cooly wage of eight annas a day does not attract him.

The supply of labour for tea gardens relies on a regular cooly force of imported labour, which is dependent on payment and can be provided with work all the year round, but as forest work is only possible for some seven months of the year, the maintenance of a labour force on tea garden lines is impracticable. Another point, too, is that on a tea garden whole families, men, women and children can be employed.

A solution was, therefore, sought in the establishment of forest village, in low-lying and cultivable parts of the reserved forests, while in the Western Range a large block of 66 square miles of grass land was reserved especially for this purpose some 20 years ago.

The conditions under which the villages were established cannot be said to have been severe.

Villagers are allowed all fuel of other minor forest produce including house posts free of charge.

They are allowed free grazing in respect of all plough cattle and ten head of other cattle per household.

Land up to 30 bighas (10 acres) per household is allowed at annas 3 per bigha, as against 8 annas charged outside reserved forests.

In return for this each adult is to render 10 days' labour without payment and up to 15 days on payment of 6 annas a day and such extraordinary labour (on payment) as may be required for extinguishing fire.

The last has practically never been utilized and the 15 days' labour on payment has rarely been fully utilized.

When villages were first started the men did only 10 days' free labour, and the additional paid labour was only utilized gradually, as work increased until now 20 days' labour is expected from each adult during the year.

In reserves other than the Western Range, this worked fairly satisfactorily, although such labour is of very poor quality, for, where there is no economic necessity and therefore no inclination to work, no man will do a hand's turn more than he need and that only in a listless and indifferent manner.

Work is also frequently interrupted, for the coolies come as a rule in batches for a few days' work at a time (not exceeding ten days) so that the men employed on any given job are being repeatedly changed.

There has also been a considerable waste of labour because it was easy to get and free.

In the Western Range the area reserved for forest villages is so large that at no time has much more than one-third of it been cultivated. Some villages have been established ever since the area was reserved some 20 years ago, and many more villages have come in since.

These village sites are more or less permanent but the population varies : villagers settle for a few years and then move off elsewhere and their places may or may not be filled up.

The number of houses in the area has been as high as 2,000, but, when a lot of land along the edge of the tree-forest was cultivated, wild animals took so heavy a toll of crops and cattle that many persons left the reserve and the population at present is about 1,200 houses representing perhaps some 2,500 adult men.

Land has been easy to get, and the rule limiting each house area to 30 bighas was not strictly enforced with the result that a large number of persons have cultivated considerably more than that amount.

These men have gradually become rich and developed as money-lenders and mahajans, and with the increase of wealth, the natural disinclination to work turned to positive aversion.

From time to time, unsatisfactory characters have had to be turned out of the reserve, and at the commencement of the general Non-Cooperation Campaign some of these together with agitators from outside opened a campaign among the forest villages, meetings were held everywhere and villagers were exhorted to refuse to

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render labour, or to pay land revenue, the exhortations being backed up by threats and intimidation.

The villagers being under no economic need to labour, the Non-Cooperation preaching sounded most attractive, so that the movement spread until the whole labour force went on strike, for as far as they could see, they had everything to gain and nothing to lose.

The bulk of the villagers are Meches, by nature an idle and backward race, and they took most readily to the movement. The remainder, Santhals, were more or less half-hearted but were kept out by the Meches. They also knew that if they refused to work, the forest officials had no force to compel two or three thousand men to do so.

Matters thus came to a deadlock and the whole labour force was on strike for a matter of three months.

The help of the Deputy Commissioner was invoked and after all efforts to persuade the villagers to listen to reason had failed, Military police were employed and from 40—50 of the leaders in the movement were turned out of the reserve, their houses dismantled and their crops attached until all outstanding revenues were paid.

As was expected, the strike collapsed at once, on the proof that firm measures would be taken and all forest villagers have continued to work satisfactorily since.

The strikers had submitted long petitions to Government laying down innumerable grievances, about the conditions under which they worked, ill-treatment by officials, non-payment and so forth. These were fully enquired into by the Deputy Commissioner and the conclusion was that, without doubt, the only grievance that really mattered was the fact, that 20 days of labour per year is exacted from each adult.

This strikes at the very root of the forest village system.

It must be admitted that compulsory labour is inefficient, and must continue to be so, until economic conditions make it necessary for a man to work as a means of livelihood in addition to cultiva-

tion ; it is a fatal mistake to allow more than a limited amount of land to each villager.

For the future ten bighas of land only will be allowed for cultivation to each adult, who renders work to the Department, and a more regularised system of payment has been instituted. Owing to the wide range over which villagers are employed it is impossible to make daily payments, so each man is at the end of his work given a printed slip showing the number of days worked, on presentation of which at the Range office he is paid.

The system of forest villages cannot in the writer's opinion be the solution for an efficient supply of labour, as the inhabitants depend on cultivation for their livelihood ; but at present there is no other alternative as there is not sufficient work throughout the year for the maintenance of regular gangs of labourers.

The disadvantages of the system may be briefly summed up as follows :—

(1) Forest village labour being compulsory is inefficient and wasteful.

(2) Not being continuous, it is of inferior value for any more or less specialized work, such as loading timber on to tramway trucks or any work requiring skill or practice, though it is good enough for cutting fire lines, clearing jungle, temporary thatched buildings and work requiring knowledge ordinarily possessed by the cultivator.

The advantages of the system are :—

(1) That it is a source of labour where none would in the ordinary course of events be obtainable, and is therefore acceptable, on the principle of half a loaf being better than no bread.

(2) Now that the money allotted in the Budget is scarce and grants for all forest work are generally cut below the irreducible minimum, it is of the greatest value to have a source of labour which, even inefficient, takes payment mostly in the form of minor forest produce which is of purely nominal

value. It is possible to carry out a great deal of ordinary routine forest work in the way of clearance of jungle, construction of forest roads, repairs of temporary buildings and such like which might possibly be cut down in budget grants but which can now be done without cash payment.

G. N. SIMEON, I.F.S.

A NEW SPECIES OF *LEPTODERMIS*.

In July and August 1886 the late Mr. Duthie collected a *Leptodermis* against which he wrote *species nova*. He apparently sent specimens to Kew where it was called *Leptodermis lanceolata*, Wall., *var*; a determination which Mr. Duthie appears to have accepted. It has been collected since and sent to Kew where it was named *Leptodermis Parkeri*, Dunn. This latter determination is no more satisfactory than the former and I think the plant is clearly a new species closely allied to both *L. lanceolata*, Wall., and *L. Parkeri*, Dunn. *Leptodermis kumaonensis*, *Parker*. Frutex ad 2 m. altus, cortex fuscus in lamellas papyraceas transversales solubilis. Folia variabilia 3-10 cms. longa, lanceolata, apice basique attenuata, membranacea, utrinque praesertim ad nervos hertella, ciliata, nervis lateralibus 6—9 paribus; petioli ad 1 cm. longi. Flores in ramulis brevibus lateralibus congesti, ramuli floriferi ad 4 cms. longi, flores sessiles, saepius quini subcapitatim fasciculati, singuli bracteis binis cuspidatis in involucrum connatis cincti. Calyx involucrum vix excedens, 4·5 mm. longus, 5-lobus, lobis ovatis obtusis breviter fimbriatis. Corolla 12—15 mm. longa, alba vel purpurascens, exter puberula, tubo basi curvato, intus piloso, fauce puberula, limbo 5-loba, lobis ovatis. Stamina 5, infra faucem corollae inserta. Stylus 4-5 fidus exsertus vel inclusus. Capsula subcylindracea 5·6 mm. longa. Semina linearia, utriculo fibroso laxe inclusa.

Garhwal near Dhanpur 2,400—3,000 m. collected by *Chandan Singh* on 23rd June 1922.

Also *Osmaston* 184, 1158.

Kumaon *Duthie* 5,634, July 1886, same number 7th August 1886, 5634a, 19th July 1886. 2,400—3,300 m. All in herb; Dehra.

I am indebted to Mr. A. E. Osmaston for showing me his field notes on this species and for writing to procure additional material. From these notes it appears that this plant is not very common in Garhwal occurring between 8,000 and 10,000 feet in the undergrowth of silver fir forest. The stems are up to 1 inch diameter, the bark peeling off in thin papery rolls, *Leptodermis lanceolata*, Wall., is a shrub of lower levels usually on open hill-sides and the bark is corky not papery on old stems. The following brief abstract shows the main points of difference between *L. lanceolata*, *Parkeri* and *kumaonensis* :—

Leptodermis lanceolata, Wall.—Leaves with 8—10 pairs of nerves. Flowers usually in clusters of 5—7 at the tips of the branches forming ample loose terminal panicles. Corolla glabrous externally, white or pinkish turning purple on fading. Seed slender with a loose fibrous covering.

Leptodermis Parkeri, Dunn.—Leaves with 3—5 pairs of nerves. Flowers usually in clusters of 3 in small panicles at the tips of the branches or on short lateral branches. Corolla pubescent externally, white or pinkish not turning purple on fading. Seed ovoid with adherent fibres.

Leptodermis kumaonensis, Parker.—Leaves with 6—9 pairs of nerves. Flowers usually in clusters of 5 or fewer, congested on dwarf side branches. Corolla pubescent externally white or pinkish (turning purple on fading). Seed slender with a loose fibrous covering.

R. N. PARKER, I.F.S.

THE WORSHIP OF TREES.

Dr. Howe, Faculty of Forestry, in the University of Toronto, contributes an interesting article in the recent May number of the *Illustrated Canadian Forestry Journal* on the above subject where he deals with the strange customs, ancient and modern, of people who endow trees with human susceptibilities. Dr. Howe, evidently with a view to enlist a sympathetic attitude towards all forest life, has taken the trouble to recite the strange customs relating to Tree-Spirits, prayerful axe-handlers, Druid oak-worshippers, tree-divinities, talking-trees, etc., and has succeeded in creating an impression that, after all, the reckless felling of trees is a matter to be guarded against and the cutting, maiming or otherwise maltreating a tree should not be done without sufficient justification, we had almost said, should be done with a certain amount of veneration. "Be not uneasy my friend," say the Filipinos according to the writer of the article to the tree apologetically "though we fell what we have been ordered to fell." And again "Axe, harm him not" and "Spirit who lodgest in this tree, take it not ill that I cut down thy dwelling, for it is done at no wish of mine, but by the order of the Overseer" are other conciliatory forms of excuse proferred by those who have to cut down trees. Some of them, according to Dr. Howe, pour butter on the stump when a tree has been felled and wind up with a prayer, "Lord of the Forest, grow with a hundred branches, etc." It is said that the Siamese Monks will not break a branch of a tree for they would thus forcibly dispossess its soul. In some parts of Austria trees are supposed to have spirits, and in certain Greek islands the wood-cutter 'prostrates himself humbly' lest the spirit should chastise him when it escapes. The Doctor then goes on to say how this idea led to offerings and ceremonies to propitiate the spirit when the tree is felled, how harvest festivals in which trees play an important part are held in Europe and other places, how barren trees are, among Malay tribes and among Slavonic and Bulgarian peasants threatened to be ill-treated or actually whipped and maimed, to produce fructification, etc.

A perusal of this article in question sets one thinking whether, after all, there is not some grave lesson to be learnt from all these strange customs and peculiar observances among people both ancient and modern. Trees, herbs and plants are useful to mankind in such varied ways, that their preservation had to be carefully guarded and their wanton destruction prevented. So much so, that our forefathers thought it wiser to endow them with supernatural powers and to envelop their treatment in the mystery of religion, faith or superstition.

Coming nearer home, we have in Travancore, and I believe, in several parts of India, traces of such belief among the Indians. There was a strong belief among the ancient Hindus that the uncalled for or unwarranted chopping off of even a branch or any part of a useful tree was invariably followed by some accident or other, whereby the miscreant lost or damaged some part of his body or limb, as a punishment for the misdeed. And some of the religious books of the Hindus give a confirmation to the theory. When a Hindu wants to build a house for occupation, he generally has recourse to a *jodishan* (astrologer) who finds out an auspicious day to permit of the first stroke of the axe on the tree to be utilized for the woodwork. Evidently the auspicious moment may be, to put it humorously the period during which the tree-spirit has got out of his dwelling for a '*constitutional*' or for a game of tennis or hockey, or, it may be in these more dissipated days, when he has to preside over a non-cooperation meeting. Be that as it may, at the specified time, the wood-cutter comes and in the presence of those present, *devotedly* and *with signs of invoking the gods* lays his axe on the tree and gives it a couple of cuts or a few more and then goes away after receiving his *dhetchena* (present) from the employer. Thereafter there is no restriction as to the time or day for cutting down that and other trees, if need be.

There is another ceremony after completion of the building called the *vasthubali*—the sacrifice to the spirit of *vasthu*—which has to be performed by the owner, if he wishes, according to the popular belief, to be saved from his house being haunted.

The spirit *vasthu* is supposed to have something to do, so far as the felling of trees for timber is concerned, and it is to appease his wrath, I believe, that goats and fowls are sacrificed and offered at this ceremony. The spirit *vasthu* is accredited to be lying on the face of the earth and in his *siesta* he reclines in a certain direction during certain months, north to south in certain months and east to west in others. When he is supposed to be lying north to south a Hindu will not fix his *yera*—(his first wall-plate) east to west for that is supposed to rouse the spirit ; neither will he fix his *first* wall-plate north to south when *vasthu* is sleeping with his body east to west. On the 10th *Medom* (Malabar month) usually called *pathamathayam* (10th day) however, the spirit *vasthu* is supposed to rise from his *siesta*, for once in the year, for a few hours and on that day, it is considered very auspicious by the Hindu to fix the first wall-plate to buildings because there is no restriction whatever as to the direction in which it is to be placed on that day, for, *vasthu*, then being awake and sitting up, cannot possibly be disturbed.

There are other practices also common among the more ignorant classes of Indians which go to show that trees and plants are held in respect by them. Konkani Brahmins have always a small *tulsi* plant in front of their houses reared on a basement of mortar and chunam, around which the women of the house, after bathing, go several times sprinkling water and muttering prayers. This serves a twofold purpose :—It is believed to propitiate the plant-spirit and gives physical exercise to the women who are often confined indoors. During recent years, the more enlightened Hindus ascribe a disinfectant property to the plant as a justification for its being reared in front of dwelling houses.

The foot of the banyan tree (*Ficus religiosa*) is often the scene of a collection of idols and snake-effigies made out of rock or granite, whereat men and women repair of an evening, sprinkle water, light lamps and place flowers, etc. The toddy-tapper at early dawn, comes to the foot of the cocoanut tree and before he attempts climbing, touches the tree-trunk with his right hand and then closes his fist and brings it reverently to his chest, inasmuch as to indicate that he invokes the blessing of the spirit

lodged therein to prevent him from slipping or falling down during his attempt to climb or when he is on the top of it at his daily routine. There is also a popular belief that the cocoanut tree will not deceive nor harm its owners, whether it is by not letting its nuts fall on our heads or whether it is by its sure return of crops, cannot exactly be understood. Still another custom which is yet piously held on to by elderly women, is the plucking of the leaves of a garden plant to wean out peevishness in infants. When a child has been crying all day and night and all attempt to pacify the baby has proved futile, an elderly woman in the house gets out, generally in the dark, and brings the leaves of the plant (*Cassia Tora*, Linn.) and crushes them in the palm of her hand and passes the whole thing round the head of the child several times, the essential obligation being that she should, during the whole proceeding, be silent and never even utter a word--lest probably she should disturb the spirit. Curiously enough, babies in some cases cease crying after this novel treatment.

These and several other practices of Indians clearly indicate that trees and plants were held in veneration and awe, as their compeers in other parts of the world have been doing according to Dr. Howe. Indeed poets of good standing have written verses in respect of trees and tree-life and almost adore them for their majesty, attractiveness and utility. Everything converges to the idea of preservation and protection of trees and to the criminality of unnecessarily harming them. In Portugal, according to Howard in his *Manual of the Timbers of the World*, it is customary to display the following inscription in woods, parks, etc., where timber trees are found:—

> "Ye who pass by and would raise your hand against me,
> Hearken, ere you harm me.
> I am the heat of your hearth on the cold winter nights,
> The friendly shade screening you from the summer sun,
> And my fruits are refreshing draughts quenching your thirst as you journey on,
> I am the beam that holds your house, the board of your table, the bed on which you lie and the timber that builds your boat.

I am the handle of your hoe, the door of your homestead,
the wood of your cradle and the shell of your coffin.
I am the bread of kindness and the flower of beauty.
Ye who pass by, listen to my prayer: harm me not."

The above puts the whole idea in a nut-shell; timber trees are useful for a variety of purposes for man and it is highly important that they should be preserved and protected. Strange and long standing customs and ceremonies such as these go to show unmistakeably how essential is the preservation and protection of tree-life and how much care, attention and tender regard we should show towards them. Do it, if you will, either out of your sentiments of religion, or your belief in superstition, or, even at least, by the exercise of your mere common sense.

To return to Dr. Howe, he winds up his interesting paper with a recital of strange customs of whipping or maiming trees to produce fructification, and here in some parts of Travancore, on Lunar eclipse nights, men go out in a nude or seminude condition and whip cocoanut trees, that have failed for a long time to bear fruits. The Doctor here ends with a popular rhyme :—

" A woman, a spaniel or a walnut tree,
The more you whip them, the better they be."

J. O. S.

BURMA REVISITED.

Everybody on the boat on the way out, told me I should find amazing changes but I was not prepared for what I found. After all, only a few years had elapsed since my retirement and I still felt comparatively young. My first objective was the Pegu Club, but after wandering about for some time I found an European who told me that it has been closed down for some years from lack of support. He also told me that many other familiar landmarks, for which I asked, had also disappeared—the Rangoon Development Trust had seen to that. We strolled along a fine avenue with imposing buildings on both sides, among

which, one particularly magnificent pile was pointed out as the office of the Ministry of Forests. I learnt that the Minister was no other than an old friend, Maung—, and I bid my acquaintance good-bye in order to go up and call on the Minister. After exchanging mutual greetings and recalling old times, I congratulated him on his high position and on the importance of his Ministry which appeared as a great contrast to my own days when the Forest Department was seldom in the public eye and was managed, merely as a part of a large office in the Secretariat.

Mg.—informed me that the great change started soon after the Reform Scheme for Burma was announced. The leading spirits of the Department in Burma after much talk decided that the time for action had come. They addressed the Local Government on the subject and demanded more independence as well as a chance of holding their own brief before the Legislative Council. They also outlined their ideals for the future expansion and duties of the Department. Especially they asked for greater liberality in money grants and loans for increasing the communications in the forests. After some difficulty and much propaganda the Department was given a Secretary of its own and the Chief Conservator, now the Inspector-General of Forests, was nominated as a member of the Legislative Council. From that date the Department never looked back. A Road Board was appointed with a view to mapping out a scheme of forest communications for the whole province. The scheme was accepted by the Council and arrangements were made to finance the scheme by loans. In view of the very limited number of experienced officers, owing to the lack of recruits during the Great War, it was definitely decided to scrap all special posts until an increased staff could allow for such luxuries, and to concentrate the cream of the staff on those forests where, owing to the great demand or the possibilities of increased commercial working, intensive work was thought to be most urgent. At the same time energetic action was taken in the question of local supply of forest produce, as it was felt that in this way the interest of the people in the value of their forests could best be aroused,

A skeleton staff only was retained to carry on in all other parts of the Province.

The immediate result of this revolution was at first a slight drop in the nett revenue but in a very few years, as more and more forest area was opened out under the Road Scheme, the revenue started mounting rapidly. Gradually the increase of trained staff allowed for an increase of the area under intensive working until the forests were the biggest revenue paying Department in the Province. Not least among the causes of the rapid development of the forests was the policy adopted in the marketing of the surplus timber for export. It was early realised, that a new timber must be introduced on foreign markets with a great deal of care. As soon as small stocks of timber were available for export, agencies were started at the centres of important foreign markets at which samples of timber were exhibited and all possible information was given. In this way gradually, as the quantity available for export increased, the demand also increased, great care being taken to see that all customers were satisfied.

After what I had seen on my arrival I was prepared for almost anything but I was scarcely prepared for such a revolution in methods as my friend the Minister had outlined, and I asked him how this could possibly have been effected by a Government Department. He replied "By co-operation with the lumber industry."

* * * * * *

I then awoke with a start and found that after a "burra-khana" during the Conservator's conference, I had only been dreaming. But into the future whence dreams come I sometimes wonder if the dream might not come true. . . . . I wonder !

OPTIMIST.

A FOREST FANTASIA.

The D. F. O. had just finished his breakfast, and was lying back in a long chair with a cheroot before starting his afternoon's office work. It was the hour for petitioners, but as none appeared he was beginning to feel drowsy when—crunch crunch—came the sound of heavy boots on the gravel outside. "Sounds like that skidder overseer" thought the D. F. O. : "I wonder what is broken now !"

He turned in his chair to meet the inquiring gaze of a weird figure on the step—a tall broad-shouldered man, a European, but bearded and unkept to a degree, white haired, clothed in garments of prehistoric cut, hung with cobwebs from head to foot, but incongruously well preserved and well fed in appearance.

"I beg your pardon" said the Apparition. "I found my way here, and—I must unburden myself—get it off my chest—you won't believe me, I know. What year is this ?"

"1985" replied the D. F. O. rising and offering the Apparition a chair, and racking his brains to think how best to deal with a madman. "Sit down" he said, but himself crossed to his office table, scribbled a chit, called his boy and sent him off—with the chit—to fetch drinks.

"Good Heavens" said the Apparition. "Then I've slept for 63 years and must be over a hundred years old."

"Come, have a drink," said the D. F. O. cheerfully as the boy appeared. "Tell me all about it."

The D. F. O. was beginning to feel interested, as his visitor showed no signs of violence, and he knew the Civil Surgeon would be over in an hour from headquarters.

"It's beginning to come back now" said the Apparition. "Is this still Burma, and is there still a Forest Department ?"
"Yes, this is Burma, and I've held charge of this Division nearly 3 years. This is the Sanbin Bungalow of Bawny Division, Prome Circle, Lower Burma." The D. F. O. thought it best to humour him and resolved to satisfy his inquiries however trivial they pepeared,

"Ah" mused the Apparition, "Now I have it. Sir, you see a man who has in truth slept for 63 years. If you will listen to me I will tell you all."

"Please do" said the D. F. O. settling his silk longyi comfortably to listen to this strange person.

"I was a Forest Officer, and like you, held charge of this Division, but it was then called Ziwati Division. When I first came here, we had just started a new policy of Forest management, of which the first principle was Concentrated Regeneration and Exploitation—but my head is not quite clear yet—we had to make big plantations to replace the forest we cut over, and we groped and groped in the dark, feeling the way to go. Most of us had different ideas, and the craving to see ahead, so preyed on my mind that at last I sought the aid of magic. I was told by some Karens of an old Talaing wizard who lived in a cave in the Yomas, and I went to him. I told him I wanted to be shown the forests 60 years ahead. He said he could not do that, he knew of no magic for it, but a brother magician from the north had just arrived, and he thought he might do something for me. As he spoke, an old man in Kachin garb came out from the cave, and they conversed together. The first wizard then said 'My brother has the shinbone of a *hnaung*, and I have a dried *yesin*.' With the two he can make a medicine which will make you sleep one year for every sip you swallow. Will this suit you? I offered to pay the two, but they would not hear of it. I threw all to the winds in my eagerness, and asked for the medicine at once. The ingredients were produced, the knife-bladed shin of the *hnaung*, and the little shrivelled "water elephant." Shavings were taken from each with a knife and placed to boil over the fire as I sat by trying to dismiss from my mind all other thoughts in my great eagerness. Presently it was ready and I took the mug they offered and sipped and sipped and sipped, I can remember no more till I awoke to-day, made my way dazed from the cave, and followed, with gradually returning faculties, the path to this house. And here I am."

The old man closed his eyes, and his head drooped as he dozed off. The D. F. O. rose quietly and stepped outside, as he

heard the buzz of the I. M. S. aeroplane approaching. The Civil Surgeon had sent an Assistant, whom the D. F. O. sent back with a note of apology saying that the patient had recovered. The plane rose again and the D. F. O. re-entered the room to find his visitor in a dead sleep.

He had heard, from his grandfather, of the wonderful power of *hnaung-yesin* decoction. He had served in the Hukong Valley and had heard tell of the *hnaung*, that curious one-legged bird which could cut its way through the jungle. And of course every one knew the *yesin*, who read the papers. He saw no reason to doubt the old man's story, and—the visitor was waking— he would be hospitable.

"Ah, I feel so much better—it must be your whisky ,Mr.—"

"Maung Waing" said the D. F. O.

"So you are the Forest Officer of 1985" said the visitor. "May I ask how the service gets its men nowadays ?"

"Oh, we have a training course of two years, but the entrance is the difficulty" was the reply. "Before we are accepted we must show a 1st class degree and other qualifications."

"What subject is the degree in ?"

"Commonsense" said the D. F. O. "And besides that we must submit a certificate that we abhor female society."

"Why so ? In my day, Forest Officers did not.........Far from it. In fact, I might say——"

"Ah, in your day, women were different. Nowadays they have no time to spare from their political occupations."

"I see" said the old man "so now Forest Officers have to live alone."

"Yes" said the D. F. O. "but they give us very pleasant quarters. My grandfather used to describe the forest bungalow 70 years ago at Nyaungzin, it was built partly of bamboos, he said."

"It was" replied the old man. "Is this house really a forest bungalow,—it looks like concrete—I remember a concrete head-quarters' house at one station, but a rest house—is it really only a rest house ?"

"Yes, only a rest house. My house at Ziwati is also concrete-built, and has lasted 45 years already. Five years ago it was decided to build all houses of concrete. The Department works on loans now, thank goodness."

"Loans were just being mooted when I lived" said the old man. "In those days we were just beginning to find our feet I think. Who is your official chief now?"

"The Forest Minister. Why?"

"In my day it was an I. C. S. man, the Revenue Secretary. And we were beginning to feel hurt."

"Hurt! Worse than that. Asphyxiated, if we hadn't got things changed. Political events then gave us our chance, and while you slept not only did the trees grow, but we grew too, released from the galling tentacles that stretched across the Bay to bind us down. Come, have a cup of tea, you must be famished."

"Oh, thanks very much, but I had a very good breakfast before I............Ha Ha Ha."

The visitor burst into a roar of laughter at the thought. His old cheerfulness had come back.

Tea rendered him even more cheerful, and his interest began to be aroused.

"Do you mind" he asked of Maung Waing " if I pump you on Forestry matters? And, better still, may I stay a few days and look round your forests?"

"Certainly, if you like," replied the D. F. O. who was now becoming as interested as his visitor. "I think I'm as keen to pump you on the past as you are to hear of the present. What about a short stroll before dusk? This is quite an interesting spot and you may see some old friends."

They left the bungalow, and the joy of the old man was beyond description. His brain was now clear, and he recognised one landmark after another as they went. It was the spot, to which his work had brought him in the long past so constantly, that each turn, each slope, was familiar. But two things he saw had changed, the paths and the trees. Each path was metalled with stone, each streamlet was bridged with concrete. But the

trees! Where he remembered patches of weedy plantations separated by untidy bamboo forest with a big tree here and there, he now saw a wood of straight-boled teak trees, looking nearly mature, interspersed with *pyinkado* of smaller girth but equally clean and straight. They turned up a hill, through the teak and *pyinkado*, till nearing a ridge top they met a contour path at right angles, on the upper side of which the forest turned to pure *taukkyan*, clean trees of enormous height, with a second story of *binga* of smaller girth. "The 1934 plantation" said Maung Waing. "You went to sleep in 1922, I think—" "I must show you the earlier coupes."

They descended again and crossed an iron girder bridge high over a sandy stream. Along the bed of this stream was being laid a railway line. "That is how we get out our timber now" said the D. F. O. "We lay that line every cold weather and take it up in May."

"But don't you still float teak?" asked the old man.

"Oh yes" was the reply. "We float as much as the streams will take in a season, but we have to get out far more than that, and this line has to bring out the balance left after the rains, both neap and new logs of teak, as well as the heavy timbers."

"They once tried extraction lines—about 10 years after your time—cut across the forest, but the rainfall was too much for them, and upkeep costs were too high. These little temporary lines are very cheap, you see."

"How do you get your logs to the streams?" asked the old man.

"Skidders," was the reply. "Tractors were tried, but were only found suitable in flat country. In these hills, only skidders are used. The Burman is a first-class mechanic, and the modern skidder is almost fool-proof. Why, we never deal now with a log of over 60 cubic feet. No wonder you had to use elephants in your day, with all the big stuff you tackled."

"Are they ever used now?" asked the other.

"No. Simple reason that there are none. They were all exterminated by disease some 30 years ago. And we weren't

ready, either. Terrible mix-up, there was. We killed out most of the buffaloes from overwork, before we had our mechanica appliances ready, and then of course they came expensive, as we were still clearing old forest, and hadn't reached full concentration of work."

By this time they had reached the compartment where the early concentrated work was started.

"This is Coupe VIII" said Maung Waing "planted in 1925 and now 59 years old. That was 3 years after you were here, so I dare say you had a good deal to do with the way it was done. I don't wish to be rude, but I should like to ask you—why was it that you didn't break away much sooner from the gospel of close planting of teak? Even in 1925 this teak was put in 9′ × 9′, and only 5 years before it was 6′ × 6′."

"Well," said the old man, we had to keep down weeds, you see. We did begin to realise that weeds could be kept down by letting other trees come in, and I remember making great efforts to get *binga* and *hnaw* in, by broad-cast between teak at 9′ × 9′. But we didn't get beyond the experimental stage in my time, and couldn't afford to space teak wider than 9′ × 9′, for fear of the broad-cast not succeeding. And it was impressed on us that to exceed a cost of Rs. 20 per acre on establishing a teak plantation was to risk actual loss on our invested capital."

"Good gracious, Sir,—excuse my astonishment—have you any idea what we are making on our final yield now? Over Rs. 10,000 per acre on the best soil from teak, and not less than Rs. 3,000 even on our cheapest species. Clear profit! What is that, discounted back 60 years, say at 4½ per cent? Yes, we are making fabulous profits now from the old cheaply established plantations of your day. Hence these roads and bridges you see. But we had to revise our methods in the 60's, when taungya-cutting went out Luckily they had already made fairly exhaustive experiments in departmental clearing and planting by which we profited, but our chief debt is to the work of the 20's and 30's in connexion with spacing and the introduction of accessory species."

" This is all very muddling " said the old man. " My brain won't take in the developments of 60 years all at once. Do tell me how you regenerate now."

" Now ? " replied Maung Waing. " Now, we are regenerating in the second rotation ; a very simple matter. Take this area now. It is the teak area of 1924, and is to be felled this year and regenerated next. It has been fire protected for the last three years and we expect to get a fair growth of teak seedings from seed, cast already. You see the under-storey of *pyinkado* ? That was put in by stump planting after the second thinning done at 15 years old, at 36 feet spacing, and each tree carefully protected and tended. The average girth of the teak in this area (about 60 acres) is about 6′ 9″, as only the best soil was selected—1924 was almost the first year in which this obvious policy was adopted. Its growth is very uniform. The *pyinkado* varies from 3½′ to 5′ in girth. The total stock per acre works out at 30 teak and 30 *pyinkado*.

Our plan here is to clear fell and extract both species over the whole area before next January—one year hence. The tops and rubbish will be fire protected till 15th April and then burnt, as fiercely as possible. The teak as you see have been girdled. This was done last April, so by next January it will have stood girdled for nearly two years. Teak logs will float out in the ensuing rains, and those that do not, will be railed out later. Each teak tree is expected to give 2 or 3 logs and in all about 2 tons of timber. *Pyinkado* will yield in most cases bottom logs convertible into sleepers, and in all cases house posts or scantlings about 1 ton to each tree.

After the burning in April, the area will be cleared of rubbish and left to itself till about the end of May. Then, after a weeding the soil will be raked over and *binga* seed scattered all over it. Weeding will be done again late in June and again in August, by which time a fairly thick crop of teak seedlings will be established. But before this, in early June, the area will be staked out at 15′ × 15′ and 3 good teak seedlings moved and planted at each peg. These staked seedlings will be specially favoured in the weedings, to ensure strong growth.

By the cold weather, the ground should be stocked with a fairly dense crop of teak and *binga* and pretty clear of weeds. I will show you last year's area in this stage. In early March a light leaf fire will be put through the area and another late in April. In the following rains one light weeding and creeper-cutting will be sufficient. I estimate the cost at Rs. 8 per acre in the first year and Rs. 3 in the second. You will see that in regenerating the pure crop we have approximated to the cost of taungya regeneration in the old days."

"Yes" said the old man. "Felling costs you nothing, being debitable to extraction, and your weeding cost is the only heavy item. How are you going to deal with your crop after establishing it?"

"Well" said Maung Waing. "I had better explain our thinning and underplanting scheme, which has become pretty well crystallized by now. Our future teak crop after 2 seasons consists of teak at 15′ × 15′, or about 190 to the acre, standing in a dense mixed crop of teak and *binga*. The staked teak are stronger than those growing between, and maintain themselves without aid till we find it necessary to thin them. That is not till the 15th year, by which time they will have attained an average breast girth of at least 2½ feet and a height of about 75 feet. In the accessory growth, the teak is usually removed in about the 5th year and the *binga* allowed to grow on till the thinning at 15 years. This thinning consists of—

(*a*) Removal of alternate teak trees, bringing down the stocking to about 95 per acre;

(*b*) removal of all *binga*.

The produce of both these operations is saleable, the teak as posts and the *binga* as fuel. In the hot weather following all rubbish from the thinning is burnt and the area staked at 36′ × 36′ for the introduction of *pyinkado*. This is done by putting out 2 year old "stumps" from nursery lines. The cost of the weeding in the next rains for the sake of these *pyinkado* plants is much reduced by the coppice growth of *binga* that comes up, and seldom comes to more than Rs. 6 per acre inclusive of the planting.

The *pyinkado* grow strongly, and in another year are well above the *binga* coppice and profiting by its assistance against weeds and creepers."

"But" said the old man "is that the only thinning you do."

"We do one more in the teak" said Maung Waing "in the 25th year, when the teak average 3′ 8″ in girth and 100′ high. This brings the teak stock down to about 30 per acre, about equal with the *pyinkado,* which by that time requires more light and benefits by the opening in the teak cover. After that thinning we leave the plantation to itself, and the *pyinkado* fits itself into the gaps."

"What is the exact advantage" asked the old man "of bringing in your *pyinkado* so much later than your teak? It means such a short rotation."

"Well, there are two reasons really, one economic and one silvicultural. We find that the economic exploitable girth of *pyinkado* is low, for nothing of larger size than sleepers are required of it, and scantlings and posts and other building specifications are even more important. So we need not grow trees larger than 5′ in girth. And we find that *pyinkado* up to 45 years of age keeps its crown below the level of the crowns of the teak and does not interfere with the side light required by every teak tree throughout its life. Teak when growing in natural forest—we still have a little left for 'show' purposes—always does best when surrounded by bamboos or lower crowned trees. We realised that, and fixed upon *pyinkado* as being at once the most suitable and the most valuable species to grow as the second storey. It must have been about your time, that Forest Officers first saw the mistake of growing teak close."

"It was" said the old man "I remember myself being laughed at for supporting the then heretical idea that a wider spacing might result in clearer stems. Our close plantations were full of trees with lumpy boles and epicormic branches, and yet the old school stuck to their ideas. There was a monograph written I remember, in which thinnings before 15 years—in 6′ x 6′ teak plantations—were declared unnecessary! The idea was that close stocking killed off side branches earlier."

"I expect it did" said Maung Waing, "but how about crowns? The crown is surely the measure of a tree's healthy growth. Possibly the old Forest Officers were too much influenced by European analogies. But surely they misinterpreted them. There is no tree in Europe which puts on a mean annual height increment anything like that of teak. Our yield tables for first quality give a mean height increasing from 33 feet in the 5th to 100 feet in the 25th year. It follows that the period of intensity of thinnings in such a crop must be very much earlier in its life than in the case of a slow growing species like oak."

"I agree with you" said the old man. "I remember remarking on the inability of teak when heavily thinned at 30 years or so to close its crown-canopy. Trees of that age should of course have already had full crowns. They did not, in our old plantations at least, barring a few that had found room to grow them by mistake."

"Why" said Maung Waing "in our training course we did analyses of trees in teak plantations dating from 1890, I remember, and the most noticeable thing about them was the rapid slowing down of girth increment after the 5th or 6th year, and—it often hardly recovered at all. Please look at this stump here last year's felling—what do you think of that?"

The old man looked and nodded.

"Not much checked growth about it, is there?" said Maung Waing. "That plantation was made just after your time, 9′ × 9′ spacing, and records show that it had a 50 per cent. thinning at 5, 10, 16 and 25 years, and then not again. Felled at 60 years, girth 7 feet, and still growing vigorously when felled, judging by the last ring. Our wider spacing of these days needs fewer thinnings and produces the same result."

"What about your other species?" asked the old man.

"Well, in this Division our working plan is primarily for teak and practically the only species we grow apart from the teak and *pyinkado* mixture are *taukkyan* and *hnaw*. We have now been able, since the most recent investigation of soils, to classify our forest soils here into A, B and C qualities. 'A' quality we

devote to teak and *pyinkado*, 'B' to *taukkyan* and 'C' to *hnaw*. All are grown on the same 60 year rotation, for convenience in regeneration and extraction schemes, as the variations in soil are often minute and complicated *taukkyan* must be grown to a big girth, at least 7 feet, owing to its big sapwood and its use for panelling. *Hnaw* timber is only required in small specifications, quite small, bobbins and turnery and brush backs and............and.........."

At that moment Maung Waing awoke and found it was only a dream.

It was 4 o'clock, and there was just time for a cup of tea before his aeroplane came over to take him to the club at Zewati for tennis.

However, it had been a dream after his own heart. Maung Waing had always loved showing people round and lecturing to them!

"TAWKYET."

Glossary	... *taukkyan*	...	*Terminalia tomentosa.*
	hnaw	...	*Adina cordifolia.*
	binga	...	*Stephegyne diversifolia.*
	pyinkado	...	*Xylia dolabriformis.*
	hnaung	...	A legendary bird of Burma with peculiar habits.
	yesin	...	The water elephant, a taxidermic monstrosity. (See *Indian Forester*, Vol. XLIV, page 88.)

VITEX NEGUNDO AND MALARIA.

To the inhabitants of this little and once charming health resort, *Vitex Peduncularis* as a malarial antidote was great news. The July number of the *Indian Forester*, 1921, spoke of *Vitex peduncularis* and the writer explored the forests of Savantvadi State with a view to find the species, but the species could be found neither in the State nor in the adjoining districts of Belgaum, Dharwar and Canara. Instead, *Vitex Negundo* was found in great abundance; it was also observed that the *Negundo* species had a powerful medicinal charm in its leaves and tender twigs, which property was generously availed of, by the local medicos. Expert opinion was, therefore, sought for and the verdict was fairly favourable.

Subsequently a strong decoction of ¼lb. of the leaves of *Vitex Negundo* was prepared in 40 ounces of water, the liquor being boiled down to 15 to 20 ounces. This preparation was tried on a Forest Guard who was affected by malignant tertian ague. The Guard felt relieved within 3 hours of administration of the dose but complained of giddiness for 2 subsequent days. This was about August 1921.

At this time, Mr. Metha, the Civil Medical Officer of the station, was making frantic efforts to obtain *Vitex peduncularis* specimens. To him the writer sent in March 1922, two lots of leaves of *Vitex Negundo* and *Vitex trifolia*, with the object that he might analyse and determine the clinical and pharmaceutical properties. Mr. Mehta tells the writer that an infusion of one ounce of *Vitex Negundo* leaves and twigs in 40 ounces of water, the whole quantity taken in during the course of 24 hours with sugar and milk to taste, is efficacious against malarial ague.

Mr. Mehta is favourably impressed with this plant as a fair substitute for quinine, while, the patients prefer *Vitex Negundo* to quinine, as it is stated to be free from the depressing and costive after effects of quinine treatment.

Vitex Negundo grows profusely at Dehra Dun and Rajpur.

F. X. A. S. MIRANDA,
Chief Forest Officer,
Savantvadi State.

METHOD OF WORKING BAMBOOS.

Experimental plots to ascertain the best system of working *Dendrocalamus strictus* bamboos were laid out in 1910 by Mr. R. S Troup and these have been examined in detail annually since. The results of the first eight years were written up by Mr. E. Marsden in the *Indian Forester* of April 1918 and certain tentative conclusions were drawn by him.

Since that publication further facts and figures have been obtained and it is considered that more or less definite conclusions can now be arrived at, at any rate on certain points.

In order to give a clear idea of the whole experiment, the various methods adopted will be briefly explained. The experiment was divided into three parts—each part having a definite idea and a definite object. The three parts were not however kept separate, but were amalgamated to give as many variations as possible, so that cuttings at various heights were all worked on different rotations and *vice versâ*, giving a very complicated mass of figures from which it has been very difficult to extract the important points. The results have however been boiled down, and the figures obtained, give a very fair idea of the experiment as a whole and the conclusions which it is possible to arrive at.

The three main divisions and the sub-divisions of these were as follows :—

1. *Different Rotations* (a) Cutting bamboos annually.
   (b) Cutting bamboos every second year.
   (c) Cutting bamboos every third year.
   (d) Cutting bamboos every fourth year.

2. *Cutting all or a proportion of the bamboos.*—This was only done in the case of the one and two year rotation clumps.

3. *Cutting at different heights* (a) Above the first node, *i.e.*, close to the ground.
   (b) Above the third node, *i.e.*, close to the ground.
   (c) Above the fifth node, *i.e.*, close to the ground.

Note.— In no clumps were new shoots of the previous rains cut.

Mr. Troup selected two localities in the United Provinces, the one dry and the other comparatively damp. Ranipur in the Dehra Dun Division was chosen as the dry locality, and Kotdwara in the Lansdowne Division as the damp locality.

At Ranipur 3 clumps and at Kotdwara, 5 clumps not adjoining each other, but distributed over the experimental area, were subjected to each variation of the experiment, and as there were 19 of these variations, there were 95 clumps at Kotdwara and 57 clumps at Ranipur under observation throughout the experiment. Unfortunately, practically all the clumps at Kotdwara flowered and died in 1919 so this area was abandoned in that year.

Before the experiments were started the clumps had been worked under a three-year rotation, all culms except the shoots of the current year being cut. No clumps, therefore, were more than two rains old. Before work was begun all clumps were thinned of dead and imperfectly developed culms.

It is not proposed to go over ground already covered by Mr. Marsden's article in the *Indian Forester* of April 1918, but merely to confirm or disprove his tentative conclusions.

1. (*a*) *Rotation.*—In the first place *annual clear felling* of bamboos (except the new shoots) is now proved to be highly injurious to the clumps. It not only leads to a reduction in the size of clumps, in the number of shoots produced and in the girth of culms, but it eventually kills the clump outright. Out of the 24 clumps thus treated all were dead at the end of 9 years. Cutting only half the number of culms in the clump every year, is undoubtedly less injurious but not to be recommended. Out of 24 clumps treated in this way, 8 were dead at the end of 10 years and 4 were in poor condition. The remaining 12 were good. It may be concluded therefore that a one-year rotation for bamboos is out of the question.

(*b*) *A two-yearly Rotation* on the other hand has given much better results. At Ranipur for example out of the 9 clumps cut on a two-year rotation (taking out only half the number of culms at each cutting) after 12 years all the clumps

were alive except one which died in 1911. Their general condition was good and during these 12 years, they have yielded an average per annum of 3·2 culms, mean length 19·6 ft. and centre girth 2·5 inches.

In the nine clumps treated under a two-year rotation, but out of which all the culms were cut (except the new shoots) the results were not so good, five were dead after 12 years and the other four were in fair condition only.

(*c*) *The three-year Rotation* clumps unfortunately had all the culms cut (except the new shoots) and no steps were taken to compare cutting, only half the number of culms, as was done in the one and two-year rotation experiments.

In the three-year Rotation Clump.—At the end of the fourth rotation, *i.e.*, *12 years, four of the nine clumps were dead and five* were alive, two of which were in a poor condition.

(*d*) *The four-year Rotation* clumps were all failing at the end of their third rotation, *i.e.*, 12 years, but only one was actually dead. Here again no effort was made to compare cutting all the culms and cutting only half the culms.

2. *Cutting all or only a proportion of the culms in the clump.*—This part of the experiment certainly gave a definite result inasmuch as it proved beyond all doubt that cutting all the bamboos out of a clump (except the new shoots) was highly injurious to the clump but as it gave no definite conclusions as to the exact number of culms to be cut, a further experiment was started in 1916 with the object of trying to get some accurate information on this important point. The experiment has not been running for a sufficient number of years to justify a publication of the results as yet, but a short resume of the lines on which it is being conducted, will not be out of place here and may prove of interest to anyone who is working bamboos on indefinite lines.

(1) It was considered that there was a great objection to prescribing definitely a minimum number of culms to be left in the clump at each cutting, because the number so prescribed would be too high for some clumps and too low for others. And secondly a *prescription enforcing the retention of a proportion*

of the old culms is practically impossible to maintain, owing to the difficulty of checking the work, and extractors would undoubtedly leave the smallest old culms in preference to the larger ones which have a greater commercial value.

It appeared, therefore, that some happy medium ought to be found taking into consideration (1) The size of the clump, (2) The number of new shoots, and (3) The minimum number to be left.

Now the existing number of new shoots in a clump forms a very fair criterion of the size of that clump, *i.e.*, large clumps produce a proportionally greater number of new shoots than small clumps, and as all new shoots should be left untouched, this provides the necessary check. It was considered, therefore, that a rule prescribing the retention of a multiple of the new shoots and varying with the size of the clump and therefore being easy to check would be the most suitable, and, with this idea in mind, this new experiment was started with the object of arriving at what that multiple should be. If definite results are forthcoming such a rule would be reasonable and perfectly practicable but so far the experiment is not sufficiently advanced to indicate definitely what that multiple is and with what rotation the best results are obtained. Up to the time of writing, the results obtained indicate that a multiple of two on a three-year rotation or a multiple of three on a two-year rotation, will give the best results but these figures must not be taken as definite, as it is too early yet to lay down anything based on conclusive evidence. The chief objection to the above is that basing the number of culms to be cut on the number of new culms produced means that, when, owing to a bad year or some other cause, no new culms are produced then, theoretically no old culms should be cut. But, as in practice, some old culms must be cut, it is essential to prescribe that a minimum number of old culms must be left untouched, and although varying in individual cases, this minimum number would probably be about five or six. Here again it is impossible to give a definite figure as yet, but from observations made throughout the experiment it can be taken that the final figure will be one or other of those given.

3. *Cutting at different heights.*— From twelve years observation of the effect of cutting bamboos at different heights it can be definitely stated that the height of cutting has absolutely no effect on the future of the clump. Generally speaking high cutting results in a mass of small switches round the base of the clump, and as these are of no economic value and make cutting more difficult, high cutting should be avoided. Low cutting also produces a few switches, but in this case they are never so numerous and very often die off as the old culm base dries up. Low cutting also has the advantage of a greater length of bamboo for sale and this is naturally the mode of cutting most favoured by extractors.

H. TROTTER, I.F.S.

PROTECTION OF CONIFEROUS SEEDLINGS.

The writer has often been struck by the neglect of seed beds in the forest after germination has successfully taken place and have long been convinced that the unprotected seedlings die off in the majority of cases in their first or second hot weather.

In July 1921 about 150 acres were sown with *Pinus longifolia* seed in two forests in the Rawalpindi West Division. The seed was sown broad-cast, in hoed up patches about 6 square yards in area, felling debris having been previously burnt on the patches and mixed with the soil. Germination was excellent and, though grasshoppers accounted for a good many seedlings, the appearance of the areas sown was still good in the autumn of 1921 In order to give the plants a fair chance of survival steps were taken to protect them and in the autumn the beds were roughly protected with brushwood. In March 1922 more systematic steps were taken to protect them through the coming hot weather. The following measures were adopted:—

(*a*) *Chir* branches and brushwood were laid over the seed beds.

(*b*) Shrubs and broad chips from felling refuse were planted upright in the beds so as to protect seedlings from the south.

(*c*) Similar chips were laid flat on the ground between the seedlings so as to keep the moisture in the soil.

On May 21st the area dealt with on a western slope in Sambli Beramal Reserved Forest compartment 83 (*i*) at an elevation of about 3,500′ was inspected. It may be mentioned that though the slope is a western one the gradient is slight and the beds referred to below were fully exposed to the sun by 8 A.M. and that the soil was apparently of the most miserable quality. The results of shading the young plants are marvellous and have exceeded all expectations. The generally excellent growth might be ascribed to the use of wood ash and to the hot weather having been a wet one up to date, but a comparison of the more exposed and less exposed seedlings leaves no doubt whatever of the enormous beneficial effect of shade. This can only really be appreciated by inspecting the area but as an example it may be mentioned that the seedlings on the south side of a line of erect chips were 5 inches high, as compared with the 3 inches in height of those on the southern side, the seedlings being within a few inches of one another. Seedlings 6 inches high are common and two giants were found 11 inches high. Natural seedlings seldom attain a height of more than 1½ inches in the first year in the Rawalpindi district. The more complete the shade, the greater was the growth and the better the appearance of the seedlings.

The following notes were made on the effect of the different measures used :—

(*a*) Spreading pine branches or *Myrsine africana* on the beds, bad. The needles of the former fall off and press unduly on the seedlings and the latter collapses bodily on to them owing to its thin flexible branches.

(*b*) *Myrsine africana* when planted erect, very good.

(*c*) Spreading *Carissa spinarum* on the seedbeds, excellent. The stiff branches prevent the shrubs collapsing on the young plants, and, even when the leaves fall, the thick interlacing branches give a very considerable amount of shade. The best results of all were obtained where this shrub was piled thickly on the beds.

(*d*) Planting erect chips from felling refuse, good.

(*e*) The protection of the soil between the seedlings by means of felling chips without shading the seedlings seemed to exercise little effect. The object of this measure was to keep the moisture in the soil and perhaps the effect would be more noticeable in a dry season.

It may be mentioned that the above protection work cost nothing being done by the beat guard. It has been suggested that the sowing of a few *Dodonæa viscosa* seeds with the pine might be advantageous in creating a natural and permanent shade.

M. R. K. JERRAM, I.F.S.

BEAUTIFUL INDIAN WOODS.

The new offices of the High Commissioner for India, which comprise Nos. 42, 44 and 46, Grosvenor Gardens, Victoria, S. W., received their official inauguration on Tuesday afternoon, August 1st, when Sir William Meyer held a reception at which a large company was present. A notable feature of these premises is the beautiful furniture and decorative woodwork carried out in the timbers of India and Burma, many of which were exhibited in the Empire Timber Exhibition held in London in 1920.

The front door, which is the main entrance of No. 44, is Andamans padauk, a finely figured wood of a brilliant reddish golden colour. The door is made in a very handsome design with bronze elephent heads forming the knockers ; it is surmounted by the Royal Coat of Arms in bronze. When exposed to light and air, this wood tones to a very attractive golden brown appearance and we noticed that the doorway is already beginning to assume this colour.

After passing the first entrance hall which is panelled also in padauk, the visitor enters the inner hall and faces the staircase, which is panelled up to the height of the ceiling in magnificently designed panels of Indian silver greywood bordered with cross

bandings of Andamans marble wood and decorated on the pilasters with very richly carved swags of the Grinling Gibbons character in Indian white *chuglam*. The whole fitting of the hall in this silver greywood is very pleasing, rendering the dark London hall bright and enlivened by the colouring and reflection of the woodwork. The panels are of large size, measuring some 10 feet in height and the wood has been well selected and skilfully matched by an expert craftsman. These panels extend the full length of the inner hall and on the staircases, and landings of the first two floors.

The doors on both the ground and first floor are also of silver greywood of similar design. On this first floor is the large room which is to form the Museum, for the display of specimens of Indian and Burmese arts and crafts. It comprises the whole of the first floor of No. 44, and provides a magnificent room for the purpose for which it is to be used. The whole of the flooring throughout this floor is in Indian silver greywood parquet strips, formed in an attractive pattern. The numerous show-cases are also made in Indian silver greywood with a ground pattern of parquet character.

The silver greywood in the hall and staircases has been French polished in the usual manner, but the parquet flooring on the first floor and the show-cases have been finished with a dull clear wax polish, so that the two different methods of finishing the wood-work can be seen, both of which while very different are equally attractive.

The most beautiful room, however, and one which we confidently predict will be considered by all who see it to be the outstanding feature of the whole of the woodwork, is the Indian laurel wood reception room on the ground front floor. This large room is panelled to the height of about 10 feet with this magnificent new timber. The colour is the same as that of the very finest Italian walnut but the richness of the grain and figure is far superior. The variation between the ground colour, which is the same as it is in walnut, and the striking grey and umber shaded lines alternating with deeper coloured wavy streaks presents a very beautiful appearance. In one carved mantelpiece and overmantel there is an inlay of figured Himalayan walnut burr. The general

tone of the room harmonises with the furniture, which is of Andamans *koko* wood, the chairs being copies of an old Chippendale pattern. The flooring is also executed in Andamans *koko* and both it, and the chairs are finished with a dull clear wax polish. The Indian laurel wood is the same wood as used in the voting lobbies in the New County Hall which was recently opened by H. M. The King. The room in the London County Hall has been greatly admired, and we venture to say that this and the room for the High Commissioner of India may easily be said to be two of the most beautiful rooms in London.

The back room on the ground floor is to form the new library. This is very handsomely designed and is executed in Andamans padauk; and the bookcases which line the room are of the same wood. This wood with its remarkable brilliantly rich colour is practically new to decorative art so far as London is concerned though it has long been a favourite medium in America where it has been largely used.

The colour of padauk and of all other woods used here is absolutely natural, no colouring matter of any kind having been used in the finishing.

At No. 42, the reception room with its mantelpiece and overmantel is panelled to a height of 10 feet in Andamans *koko* wood, which has here been treated in a different manner, for the panels are very wide and long, and have been selected with a rich wavy grain, and the wood is French polished. *Koko* is of a variable golden brown colour with a very transparent and pleasing grain. This room has a parquet floor of Burmese *gurjun*, a wood which is obtainable from both India and Burma. It is of a reddish brown colour and has a beautiful surface and good appearance. This wood has been used in the new premises of the Bank of England and in many other places. It has a very even grain and hard wearing surface, and is one of the best flooring woods it is possible to obtain.

Very handsome furniture, consisting of tables, chairs, writing desks, office chairs, etc., is on view. Amongst the most noteworthy of these might be mentioned a copy of an original Sheraton bookcase finished in padauk which is in the High Commissioner's

room, a book or china cabinet case in silver greywood which is in the Secretary's room, and perhaps the finest specimen of all, a superb chair—a copy of the original Chippendale Peacock chair which has been made in *koko.*

The padauk used in the bookcases has been treated in a different manner from that of the panelling much darker coloured wood has been selected. The whole of the wood used in the work was provided from logs despatched by the Government, specially selected and sawn, and all the timber has been artificially seasoned. The entire work in the offices was designed and executed by Messrs. Waring and Gillow, Ltd., and the furniture made by Messrs. Waring and Gillow, Ltd., Messrs. Coals Lovell and Co., the Metropolitan Joinery Co., and Mr. G. H. Caffall.

All the wood was selected by Mr. A. L. Howard of Messrs. W. W. Howard Bros. and Co., who are the Sole Agents for the sale of timber for the Governments of India and Burma.

EDITORIAL NOTES.

We have received a copy of the Programme of the opening ceremony of the new County Hall of the London County Council which contains a description of the building and several illustrations. We can well believe our correspondent's statement that after the Houses of Parliament, it is the most prominent public building in London and it gives us all the more pleasure to note that the square voting lobbies, north and south of the Council Chamber, have been panelled in Indian laurel wood which is referred to in the Programme as an "extremely beautiful wood." The development of the demand for Indian Timbers in Great Britain, is the result of the interest and energy displayed by the Government Sale Agents Messrs. Howard Bros.

We regret the omission of the name of Messrs. W. W. Howard Bros., London, in the report on "Ideal Homes Exhibition" which appeared in the August number of the *Indian Forester.* They organised the whole of the India and Burma Exhibit and the success was entirely due to the great enthusiasm which is being displayed by them, in developing the demand for timbers of the Indian Empire.

REVIEWS AND EXTRACTS.

REPORT OF THE BAMBOO FORESTS OF THE LOWER MAHANADI BASIN.

BY J. W. NICHOLSON, DEPUTY CONSERVATOR OF FORESTS.

This report is the outcome of a survey of the bamboo resources of the Angul Division and the neighbouring states made to ascertain whether sufficient supplies would be available to feed a paper-pulp factory if one were established at Cuttack, a site, which in other general respects, possesses the essential qualifications.

The bamboo stock of the district consist almost exclusively of *salia (Dendrocalamus strictus)* and *daba (B. arundinaceæ)* with the former so predominant that the latter may be neglected or relegated to the position of a reserve supply against an expansion of the industry considerably larger than it is necessary to visualise at the present moment. This adds to the attractions of the project, *salia* being one of the most suitable bamboos for the purpose while *daba* is several grades lower down in the scale of desirability. The report gives a satisfactory answer to the question whether a factory could rely on a sustained annual crop of 25,000 tons in the statement that Angul alone could supply this amount entirely from the *salia* area at a cost of Rs. 13 per ton delivered at Cuttack, and 42,000 tons, if the cost limit is extended to Rs. 15 per ton, in addition to which 12,000 and 22,000 tons at similar cost figures could be obtained from the Native States. The progressive cost statement given on page 31 is a feature which should appear in all such reports in future. Equally commendable, are the statements giving estimated yield and cost which are printed across each forest block in the accompanying map.

In estimating costs full recognition has been given to the inevitable increase, which follows the introduction of a new and large demand for labour in a sparsely inhabited area, as much as 66⅔ per cent. being in some cases added to present costs,

On the important matter of reproduction Mr. Nicholson comes to the conclusion that the average annual product of new culms is approximately one-sixth or one-seventh of the whole stand. On the latter basis he works out (see table on page 9) the sustained acre yields per annum. There is a slight want of clarity here. Taking the first line of the table referred to, it would appear that the block in question will yield 6½ cwts. of dry bamboo per acre, a quantity too small to be worth working. These figures must be read in connection with an earlier statement, that a three years cropping rotation is contemplated, consequently the exploiter is not expected to take away 6½ cwts. every year but three times that amount every third year.

One purpose of such report is to induce capitalists to visit the areas reported on, and form their own conclusions as to whether they meet their requirements. We suggest that future reports of a similar nature might end with a short note as to ways and means of reaching the points of interest, with the addresses of local officers, transport and garage agencies, etc. As a case in point the writer made a flying visit to Angul, a few months ago and found it most unget-at-able, but solely because he did not know how. He is still in doubt as to whether the time he had to spend in Cuttack, ferreting out ways and means was spent to the best advantage, judging by the circumstance that he had to spend a particularly cold night by the way side, as a result of the breakdown of the archaic motor he succeeded in unearthing.

Mr. Nicholson is to be congratulated on a report which, both in form and substance, may well be adopted as a model for similar efforts in the future.

W. R.

POWELLISING OF TIMBER.

Some time ago, investigations were undertaken by the Forest Products Laboratory in Perth into the process of timber impregnation known as Powellising. Owing to lack of funds, these investigations have not progressed as steadily as was hoped, but nevertheless, a great deal of good work has been done already by Mr. R. A. Fowler, who is at present acting as officer in charge of the Laboratory. The following brief notes on the subject of Powellising in Western Australia, prepared by Mr. Fowler, should prove of much interest to readers of the Journal :—

The Powell Wood process has been investigated in this aboratory for the last two years and information concerning it collected from many sources. The following summary may indicate the known facts in the possession of this laboratory with reference to the process.

History.—The process known as Powellising is the result of a discovery by Mr. Powell, a Liverpool merchant, who patented it in 1904, and formed a company to develop it. Messrs. Bethell and Gorton introduced the system into Australia in 1905, and obtained patent rights in Australia and New Zealand. In 1905 the process was introduced into Western Australia and a small plant erected at East Perth. Just prior to this Mr. Julius, a mechanical engineer in the Western Australian Railways and Mr. Light, Engineer for Existing Lines, treated some Karri sleepers at Midland Junction in an experimental fashion and had them laid at two points on the railway.

In 1908 the Government erected a plant at Bunbury. This was first erected to treat 230,000 sleepers for the Port Hedland Railway, and has been in constant use ever since.

Plant and Process in Western Australia.—There are three powellising plants at present operating in this State—all under the control of the Government. The Railway Department have a plant at Bunbury capable of dealing with 7,000 sleepers a week. The State Sawmills have two plants—one at Manjimup and one twice the size at Pemberton. The Bunbury plant consists of

three boiling vats, 62 ft. × 7 ft. 6 in. × 7 ft. 5 in., heated by steam from four boilers of the loco type, 24 horse-power each.

The plant at Manjimup consists of three boiling tanks 89 ft. × 9 ft. 6 in. × 9 ft., and abundant steam-heating power for radiators derived from three Babcock and Wilcox boilers.

The plant at Pemberton is twice the size of the plant at Manjimup.

The process consists of placing the sleepers or other timber in the tanks and admitting the mixture of water, molasses, and arsenic, in the proportion of about 8 per cent. sugar and 2 per cent. arsenious oxide. The whole is then brought to the boil, and kept vigorously boiling for a period depending on the thickness of the timber to be treated—three hours boiling being allowed for the first inch and an extra hour for every additional inch in thickness. Steam is then turned off, and the whole allowed to cool down to atmospheric temperature, taking about forty hours. The liquor is pumped away and the timber hosed down and stacked in the yards to dry.

The idea of the process as expressed by Mr. Powell, is that at the boiling temperature in the vats the sappy matters in the timber are converted into steam and driven out. In the subsequent cooling, the preserving liquid is forced in by atmospheric pressure to take the place of the material withdrawn.

Laboratory Work.—There were two questions to be solved in the laboratory with reference to this process. The first was to determine whether the preserving liquid really reached the centre of a sleeper of such hardwoods as karri or jarrah; and secondly what part the sugar plays in the process.

Work in this laboratory has shown that the preserving liquid does really penetrate to the very centre of sleepers treated by the process. Arsenic has been definitely found in the centre of all pieces of properly powellised timber. The sugar problem is a more difficult one, and Mr. Powell claimed that the sugar forms an insoluble compound with the timber fibre and cannot be washed out. Chemical research undertaken in this laboratory seems to show that a part of this claim is justified, inasmuch as a portion of the

sugar does seem to form a loose chemical compound with the timber fibres. This is a point of extraordinary interest and is being investigated further.

Tests of the Process.—That the process is an effective preservative against both dry, rot and whiteants must be taken as now fully established. The process has been in use for some years now in this State and the results, where they can be collected have amply shown that the process is successful. Nearly half a million powellised karri sleepers were used in the Trans-Australian Railway, principally at the western end, and have given every satisfaction, a remarkably small number having had to be removed. In the Northern Territory Railway, opened for traffic in December 1917, there were used some 94,000 powellised karri and 10,000 powellised jarrah sleepers. None of the jarrah sleepers have been replaced, and only nine of the karri sleepers. A powellised jarrah fence was erected round a railway goods shed at Broome, North-west, in 1913. This is a position subject to very virulent attacks by whiteants. Untreated karri and jarrah structures in this position are very soon destroyed by the termites. In February 1921, the Assistant Engineer-in-Chief reports that there are no indications of whiteants in this fence. This is a particularly good example of the process.

Another test carried out in the Collie coal mines was as follows :—

Pieces of powellised and unpowellised jarrah and karri 4½ in. × 3 in. were placed in position on the 20th April 1918 in a very damp portion of the mine showing rich fungus growth on the walls and roof. These pieces were continually inspected and remained in the situation until 20th September 1920, when a piece was sawn off, each specimen carefully marked by the Forest Officer and forwarded to Perth for examination. It was then found that both powellised jarrah and karri had not been attacked, and the wood was hard and sound. The unpowellised pieces of both karri and jarrah had been badly attacked, the wood exhibiting every sign of dry rot and well-nigh falling to pieces. This superficial examination was confirmed by the Government Pathologist.

Examples of the usefulness of the process could be multiplied, but the above are thoroughly well authenticated and will serve the purpose. It may, therefore, be concluded that the powellising process thoroughly carried out is a preservative of such hardwoods as jarrah and karri from the attacks of both dry, rot and whiteants. It should be noted, however, that the process does not appear to be of any use in preserving timber against the attacks of marine borers. Indeed no process of which I am aware has yet given any satisfaction in counteracting the attacks of these creatures.—[*The Australian Forestry Journal, Vol. V, No. 6, June* 1922.]

CANADIAN SLEEPERS FOR INDIAN RAILWAYS.

It is estimated that more than 4,000,000 new sleepers per annum will be laid by the Indian railways during the next few years. Canadian sleepers were not known in India until 1920, but in the fiscal year 1921 over £200,000 worth were imported from the Dominion, as compared with about £150,000 for imports from the Pacific Coast of the United States. Several large Indian orders have been secured by Canadian exporters recently.

There is some divergence of opinion, says *The Canadian Export Pioneer* amongst Indian engineers in regard to the efficiency of the creosoted fir sleeper. Some of the first Oregon pine sleepers laid in India in 1911 and 1914 were placed in stretches of line where moisture, heat, and the whiteant were at their worst and where even the best Indian hardwood deteriorated. Moreover, as some of these sleepers were imperfectly creosoted, whiteants soon got into them, and the deterioration was rapid. A few engineers, whose experience has been confined to such stretches of line, are inclined to be emphatic in their condemnation of Douglas fir sleepers. But many engineers with wide experience in India are well satisfied with the records of creosoted Douglas fir. A report made in 1921 by the Chief Engineer of the East Indian Railway, on the condition of creosoted Douglas fir sleepers which had been laid down between 1914 and 1916, show that

where the sleepers split, or where they were inclined to be knotty or twisted in grain, the deterioration was rapid. The rigid inspections now conducted by the Pacific Lumber Inspection Bureau on all shipments of creosoted sleepers from the Pacific Coast to India assure that none but serviceable sleepers are sent out. This is perhaps the greatest advantage enjoyed by Douglas fir in the eyes of the purchasing engineers of the Indian railways. One disadvantage of Douglas fir sleepers, as compared with native hardwood, is that a bearing plate must be used with the former. Douglas fir is so soft that if a bearing plate were not used, the rail would rapidly sink into the sleeper. It is absolutely essential that shipments of creosoted sleepers ordered by the Indian railroads should arrive at the times specified. This is the very essence of such contracts, because if the railroads thought that within such times they could procure sufficient supplies of Indian hardwoods, they probably would not place any orders for creosoted Douglas fir. In view of the growing difficulty of procuring native hardwood sleepers at reasonable prices, British Columbia should find a steadily increasing market for her creosoted fir sleepers in India. If the price of Douglas fir sleepers were 15 to 20 per cent. lower than at present, it is probable that the number of Douglas fir sleepers shipped to India would soon be trebled, because it is unlikely that prices of Indian hardwoods will fall much below the present levels. Competition from iron sleepers is not likely to be serious owing to their cost.—[*The Indian and Eastern Engineer*, September 1922.]

[This above information is somewhat striking, in view of the fact that the timber depôts in Northern India are, at present, overstocked with coniferous timbers and it only requires some enterprise on the part of the Railways, or private persons, to establish creosoting plants locally, and to utilize the stocks of timber which the existing markets are unable to absorb.—HON. ED.]

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THE MURUNGS.

THE *Murungs* are a tribe of people who dwell in the second fringe of the wilds bordering on civilisation, the outermost being occupied by the Mughs. These Mughs are small bodies of colonists who have broken away from the main Mugh settlements, which are to be found in the Collectorate areas, where they form compact settlements, adjacent to Hindu or Mohammedan settlements, yet distinct from them.

The *Murungs* are one of the numerous tribes of shifting cultivators which go to make up the population of the Chittagong Hill Tracts They have a permanent village in a locality selected with a view to obtaining the best advantages of a continual supply of water, as also protection from the various kinds of wild animals, that share with them the peaceful solitudes of the wilds.

They are extremely clever at protecting their homes and *jhums* (cultivated areas) from the ravages of birds and beasts,

and it is a task of some danger to approach a village without a guide, as many a cleverly-concealed pitfall awaits the unwary.

The Murung is not particular what he eats; delicacies which are highly prized by the Murung gourmet would cause his European compeer to shudder in distaste. The Murung, like the other tribes in the Hill Tracts, lives by "shifting cultivation" which consists of cutting down an area of forest, which he thinks can be cultivated by the family, letting the cut material dry for a period of a month, to a month and-a-half, and then firing the lot. When the fire has burnt out and the area cooled down, the family turn out and remove as much of the burnt and unburnt material as is possible with the labour available; the remainder lies about the *jhum* to be cut up and utilised as firewood during the rains, or rots to dust. Should there be an accessible market for the various kinds of produce, which were growing on the area before it was cleared, the produce is carried to such market according to individual business ability.

When the *jhum* has been cleared for sowing, the men-folk turn out for the work which consists of making cuts in the earth with a *dao*, into which are dropped seeds from a bag containing a mixture of seeds of all the crops to be sown in the *jhum*. This sowing is made with an eye to the first April showers, so that the *jhums* are sown about April and ripen in October.

After the *jhums* have been sown, the work of the men-folk is over for the year, and the work of the women-folk begins. The women do the cleaning and tending of the crop, with occasional assistance from the men—when they feel energetic, and are usually more wideawake on the *jhum* houses to which they accompany their men-folk to watch, cut, and store the crops as each ripens in turn. The crops consist of paddy, cotton, and vegetables of various sorts. After getting in their crops, the winter store of firewood has to be laid in and all sorts of odd jobs finished off. While the women are busy, the men-folk dandle the children and loaf in the *cherang ghur*, which means the debating

house, discussing local politics, or local occurrences of note. It is amusing to see a hefty individual puffing stolidly at a pipe, with a squalling youngster perched on his hip, which another individual is trying to amuse by antics which are more terrifying than laughter-provoking.

The houses of these people are built on piles, at least a man's height off the ground, the space below the floor providing house room for pigs and other edible pets.

They are laughter-loving people, shy of strangers, and keen hunters. The only beast they are absolutely terrified of is the wild elephant, whom they never address by name but as *mamu* (*i.e.*, uncle), having the quaint conceit that the mighty beast resents the familiarity of being addressed by name, and retaliates by destroying the *jhums* of those who are guilty of this breach of good taste. This fear can be understood, as these people are most inadequately armed with muzzle-loading guns which are as much use as a pop-gun when standing up to the charge of an nfuriated tusker. The first time the writer met these interesting people was while spooring a herd of wild elephants during the course of a *kheddah* operation. While we were walking along a path we suddenly ran into a bridal party. The groom was on his way to pay a visit of ceremony to the family he was shortly to be member of. We caused an absolute panic, and the entire party sprang off the path, crashing into a *nulla* concealed by the tall grass, to the detriment of the bridal finery of the groom and his companions.

Fortunately, one of the Indian members of our party had been to this particular village before, and recognised one of the bridal party in the snapshot view he got, as they surged into the jungle. "Lapho! Lapho!" he yelled, "it is I Yakub, son of Buda Gazi, do not run." We stood quite still grinning amiably, till at length a tousled head covered with grass seeds cautiously parted the grass some distance from us, and peered suspiciously out. Fortunately, Yakub had taken up a prominent position in the picture, and Lapho was satisfied that Yakub had some considerable say in the matter, for he advanced with marked reluctance. They both commenced to jabber in some

uncomprehendable jargon, Lapho's eyes growing rounder and rounder, and nearly popping out of his head with excitement, as Yakub proceeded with his explanation. Suddenly Lapho took a few steps forward, sank to his knees, and bowing his head to the dust, commenced to babble at great length in his own lingo, bowing his head to the dust after every few sentences. On enquiring from Yakub what all the oration was about, he had the impudence cheerfully to inform us that he had told Lapho that the attention of Government having been drawn to the awful damage caused by wild elephants to the *jhums* of the hill people, we had been specially deputed to remove this trouble. That we had specially selected him as adviser-in-chief, owing to his special qualifications for the post—courage, honesty, faithfulness, etc. That he had informed Lapho of our skill in magic and knowledge of medicine, and that, unless he and his people implicitly obeyed our lightest command we were capable of bringing untold disasters upon his community. He was such a cheerful liar, yet useful withal, that we smiled at the character he had given us. Lapho who had been watching with an intentness which was not lost upon us, on seeing us smile evidently assumed that the strange white folk that he had set eyes on for the first time in his existence, were friendly; and commenced to let off a series of short barking calls and shrill whiks. The grass commenced to agitate all round us, and in less than no time we were surrounded by a chattering crowd of Murungs. As each form appeared out of the jungle a short, sharp command from Lapho caused it to instantly prostrate itself at our feet. Lapho then began to harangue us, Yakub interpreting. To this day I am convinced Yakub interpreted just as much as it suited him for us to know. For during the *kheddah* operations, conducted in the vicinity of this Murung village he was to be found more often than not installed in the head man's house, in a beatific state of mind, which had certainly not been engendered by his labours at catching elephants. At the conclusion of the harangue, the bridal party set out on its way, detaching three of their number: two to carry the news of our arrival to their village in advance, while one acted as guide to our party.

On our arrival at the village, we were met by the village elders, who conducted us to the guest-house (*cherang ghur*) and produced rice-beer. Courtesy demanded that we should oblige our hosts, so we swapped flasks, and enquired regarding the presence of wild elephants in the vicinity. The rice-beer being somewhat like cider, was not heady stuff, but the Murungs soon began to feel the effects of the Irish in our flask, and the potency of the liquid food further enhanced the prestige of the two Sahibs.

We hung about the village till our elephants turned up, when we pitched camp at some little distance from the village, as our sojourn in the wilds had made us rather particular where we camped.

The arrival of our *hathis* caused great excitement, as the Murungs had never seen elephants in captivity.

The next day a party of Murungs accompanied us on a scouting expedition for elephants, but as soon as we heard the elephants in the distance, they took to the trees, and nothing would persuade them to approach to within even a quarter of a mile of the place where the elephants were grazing.

While *kheddahs* were in progress the festival of "the boring of the ears' was held in the village, the head man's son having attained the age of manhood as it is considered amongst them, which necessitated his ears being bored. The festival commenced with a dance by the young women, while the males made up the band. There were from 15 to 20 instruments like bagpipes, the bag consisting of a hollowed-out gourd, into which a varying number of reeds were fixed, covered with wax to prevent the escape of air. The free-end was covered with a section of bamboo containing a knot lightly placed on, with the covered end upwards, the section having the outer covering removed. The reeds were of varying length, and had from one to three vent holes, those with the larger number of holes emitting a shriller note. An old crone, evidently mistress of ceremonies, was armed with a gong which seemed to have a varying number of tones. As each distinct note was struck on the gong, it seemed to be the signal

for a variation in the figures being danced. The dance consisted of the dancers and musicians facing one another in a half circle, the dancers taking their time from the old lady with the gong; while the band was directed by the gentleman with the largest bagpipe. The band commenced a preliminary ove·ture, during which the dancers marked time, yet continued to move in a circle, the band doing the same. When the dancers had returned to the position they had commenced from, the music quickened, the dancers taking two short steps forward, then posing with one foot extended, and backing the two steps they had advanced. Again the music quickened and the step changed. The dancers were now in a jumbled mass, or so it seemed us. But there was a method in the jumble, for from it emerged a series of quite fascinating figures. Abruptly the dance came to an end, the pipes wailing to silence, and the entire party adjourned for refreshments, which consisted of dipping bamboo dippers into a huge vessel of rice-beer. This alternate dancing and drinking of rice-beer went on for several days, the local medicine-men instructing the youth who was to be operated on, in the mysteries of the rites of manhood in the interim. That the instructions given to the youth were arduous in the extreme, could be seen from his condition during the brief glimpses we had of him, as he was a laughing merry soul, but seem to age rapidly each day. Naturally we were not permitted a glimpse of these mysteries, being outsiders, and our natural curiosity was invariably met with vague, yet courteous generalities. At last the day of the ceremony dawned, and it was obvious that something unusual was afoot, as the pipes skirled bravely, and the gong could be heard more frequently, booming a welcome to sightseers and participants alike. We arrived at the village, to find that the show was in full swing, and that all alike had been sampling the brew made overnight, well but not wisely. A full-grown buffalo had been fixed in a pen, with additional struts, so that he could not move an inch, and on our enquiring what the idea was, we were told to wait and see. The medicine-men were armed with what looked like stabbing spears, and were in a state of reeling intoxication, whooping, jumping, gesticulating like people possessed. While we were watching the dancing,

which had deteriorated in grace as the potations of the dancers increased, one of the medicine-men suddenly let out a blood-curdling yell, and dashing, up to the buffalo, plunged his spear into the beast up to the haft, behind the shoulder. The blood spurted out in a stream, to be caught in a bamboo *choonga* (receptacle), which when three-quarters full, was filled to the brim with rice-beer, and given to the boy to drink at a draught. As soon as the head priest had filled his *choonga*, there was a general rush to fill other *choongas* and as long as the flow of blood lasted, receptacles were being filled with the warm blood, and drained with great gusto. The sight so sickened us that we pushed off, our departure being hastened by the head man offering us a draught of the filthy mess, from a vessel he had just had a drink out of. As we were marching away we saw the youth being led away for a further course of instruction, or so we surmised. We heard later from Yakub that the buffalo had died within a few seconds of being stabbed, and that the night had been spent in feeding off his flesh and general riotousness, which he was careful to inform us he had no share in. "In fact, Sahib, had I not been at the village last night, your Honour's sleep would have been disturbed, as some of the young bloods were determined to come and dance in your Honour's camp. My presence and influence, backed by that of the greybeards, dissuaded them from this attempt." Shortly after this we made our catch, and we were much too busy attending to the noosing, etc., so that we hadn't much time to spare for our friends the Murungs. They came to see the noosing operations, and we were compelled to request the head man that he would persuade the women-folk to put on a few more clothes, as our labour differed in their ideas of the modicum demanded by the tenets of civilisation in this respect. The Murungs were greatly interested in the noosing operations, and kept us busy answering questions. On the night before we broke up camp, they paid us a visit of ceremony, with the band and a dancing party of boys. We supplied refreshments in the shape of Shajahanpur rum, which was greatly appreciated, and they danced till the small hours of the morning, such of them as could keep their legs. We parted next morning the best of friends. G —presented the head man with a kukri, while I gave

him an old topee which he greatly coveted. The last we saw of them was the head man leaning on his khud-stick, with my old topee jammed on top of his headgear, and the kukri on his shoulder. People from those parts who visit us occasionally bring us news of the old fellow and his enquiries. He still wears the old topee, which has been carefully preserved as a badge of honour that his friends the Sahibs left him.

In conclusion, what struck me most forcibly about these people was the absence of all vice, except that of having a glass too much, the cheerfulness of the people under difficulties, which would utterly dismay the average civilised man, and the splendid loyalty of the village people to the head man, whose word is law. I was not long enough in touch with them to express any definite opinion as to the position held by the women-folk in the community, but should consider that they are no worse off than in other more civilised communities. In fact, judging from certain incidents which came to my notice, I should say that they had a better time. The head man's wife certainly ruled him with a rod of iron, but this may be accounted for, either by the fact that she was a lusty wench, or because she had presented him with twins, twin-boys, both of whom were doing well, an uncommon incident in the wilds, and certainly a new departure in the village we saw, which had been in existence for a fair number of years.

M. MARCHANT, P. F. S.

CALCULATION OF THE YIELD OF A FOREST BY FORMULÆ.

SIR,—I enclose herewith a note which will appear in due course in the "Manual of Forest Management in the U. P." dealing with the calculation of the yield of a forest by various formulæ. It is, however, a matter of considerable importance in India, and for the reason I thought it might possibly be of general interest and suitable for publication in the *Forester*. The object of the note is to show that the application of standard formulæ (such as Von Mantel's and Heyer's) to Indian conditions, where enumerations of trees below 8" diameter are exceptional, and 8"

diameter also represents the limit of timber, introduces a very considerable error, and I have attempted in this note to show how the standard formulæ must be modified to apply to 8″ diameter and enumeration limits. To explain the *practical* importance of this note the following illustration will serve :—

In W. C. I of N. Kheri Division (area 48,000 acres) the yield was first fixed by Von Mantel's formula ($Y = \frac{2V}{r}$) at 16 lakhs of c.ft. per annum, estimated to bring in Rs. 8 lakhs revenue. The calculation of the yield on the modification of Von Mantel's formula indicated in this note ($Y = \frac{2V}{r-x}$, where x = age of 8″ diameter trees) gave a yield of 23 lakhs of c.ft. per annum, estimated to be worth Rs. 11½ lakhs. Thus the adoption of Von Mantel's formula would have resulted in a loss of Rs. 3½ lakhs revenue per annum from this one small Working Circle of one Division.

Howard showed two years ago that Von Mantel's formula was incorrect when applied to forests where V represented only the partial volume, and he worked out a modified formula where V represented the total volume (timber plus smallwood) of trees of half rotation age and over. This note carries on his calculations, and submits modified formulæ generally applicable to all cases where V represents the volume of trees of age x and over, with the proviso that both enumerations and volumes per tree *are measured to the same diameter, i.e.*, to a diameter of a crop of average tree of age x. In the U. P. this diameter is almost invariably 8″, so that for any species or forest, directly the age of an 8″ crop or average tree is known, the modified formula can be applied. The wider generalisation of this formula will, it is believed, make it of more general utility in Indian forests. The recently prepared U. P. sal yield table affords us the necessary data for checking (in certain concrete instances quoted in the note) the yield from these modified formulæ with the yield calculated from the C.A.I., and the fact that the latter closely support the former, and entirely disagree with the yields calculated from the original unmodified standard formulæ, is strong evidence in support of the accuracy of these modifications.

E. A. SMYTHIES I. F. S.,
Silviculturist, U.P.

There are two points in forest management in India which have a very material effect in the determination of the yield of a forest. There is first the practical impossibility of enumerating the growing stock of a forest down to seedlings, actually for the United Provinces working plans, enumerations are seldom carried down below trees of 8″ diameter. The second point is the relatively high definition of timber, which, for research work generally, and for all forests where sawn or large timber is the object of management has been defined as measured down to 8″ diameter over bark. Thus in the U. P. forests generally the *real* growing stock (V) represents timber over 8″ diameter only, and is ascertained by enumerations of trees over 8″ diameter (in standard 4″ diameter classes), the numbers of trees in each diameter class being multiplied by a volume factor representing the *timber* content. The following note examines the application of standard formulæ to such conditions for ascertaining the yield of the whole forest. The principal formulæ are (1) Von Mantel, (2) Heyer, (3) Hufnagel, (4) Karl or C. A. I As these formulæ are fully discussed in all text books (*e.g.*, Schlich and Recknagel) it is only proposed here to explain why and how they must be modified to suit conditions given above.

Von Mantel's formula is

Von Mantel's method.

$$Y = \frac{2V}{r} \left\{ \begin{array}{l} V = \text{real growing stock} \\ r = \text{rotation.} \end{array} \right\}$$

Now, this formula is theoretically correct only if V represents the whole crop down to seedlings and the wood volume of each tree measured down to 0″ diameter. Practically, of course, this is impossible anywhere in the world, but by measuring trees and wood down to 1″ or 2″ diameter we get a sufficiently close approximation. However, by measuring trees and wood down to such a high limit as 8″, a very serious error is introduced, which will be evident from the following :—

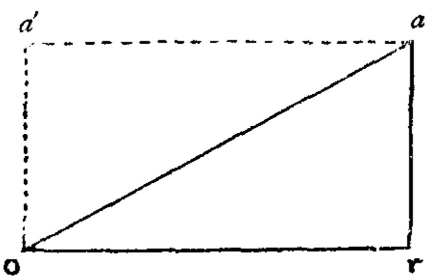
Consider three cases (all for a normal series of age gradation):—

(*a*) trees and wood measured to diameter 0″;

(*b*) trees and wood measured to a diameter equal to $\frac{1}{2}$ rotation diameter (or diameter $\frac{r}{2}$ for short);

(*c*) trees and wood measured to a diameter corresponding to an age x (or diameter x for short, in India usually 3′

(*a*)



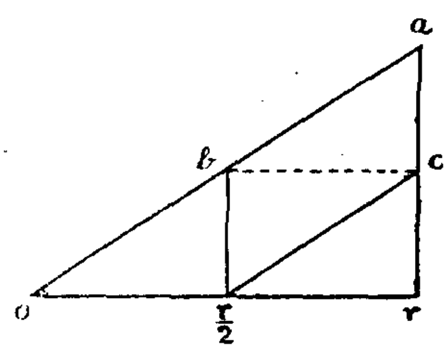
Obviously V = △aor

and the yield in r years = figure oraa′ = 2△aor = 2V, and meanwhile the areas felled over will have grown up to give the same growing stock = △aor.

∴ annual yield $Y = \frac{2V}{r}$

This is Von Mantel's formula unaltered:—

(*b*)



Howard has examined this problem (vide *Indian Forester* August, 1920), and has modified Von Mantel's formula to read

$$Y = \frac{V}{4\frac{3}{8}r}$$

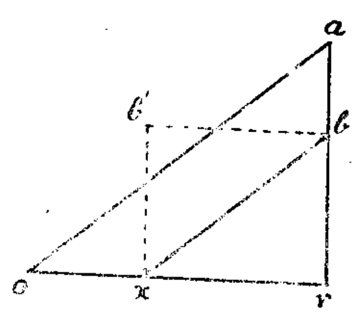
This is based on the statement that yb ignoring all trees under $\frac{r}{2}$ years' old, V = the figure ab$\frac{r}{2}$r.

This is true if the volume of total wood per tree down to 0″ diameter is included, *but not otherwise.* For it is obvious that the volume of a crop $\frac{r}{2}$ years old is proportional to the line b$\frac{r}{2}$ if all wood is included, but is zero if only wood exceeding a diameter $\frac{r}{2}$ is included. In this latter case, the growing stock V is represented by a Δ on $\frac{r}{2}$r as base, and if, as yield tables for sal indicate, the volume of small wood (*i.e.*, below 8″) in a crop remains approximately constant after $\frac{r}{2}$ years old, this V will be the Δ $\frac{cr}{2}$r.

To apply Von Mantel's formula to this V will introduce a very large error, to apply Howard's modification will introduce a smaller but still appreciable error. From the diagram it is obvious that the total yield in r- $\frac{r}{2}$ years = figure rcb$\frac{r}{2}$ = 2 V

and ∴ annual yield $Y = \frac{2V}{r - \frac{r}{2}}$

(*c*) We can now put the problem in general terms where trees and wood are enumerated and measured down to a diameter corresponding to an age x



The real growing stock V is now represented by bxr, and as before, it is easy to see that in r – x years, the total yield = figure rbb'x = 2V ∴ $Y = \frac{2V}{r - x}$.

This formula is approximately true for all values of x, provided that the crop is *both enumerated and measured* down to the diameter corresponding to age x (this diameter is in the U. P. generally 8″). To apply Von Mantel's formula to this limited growing stock is wrong, and the extent of the error introduced is evidently

$$\frac{2V}{r-x} - \frac{2V}{r} = \frac{2V}{\frac{r}{x}(r-x)} \;*$$

The adoption of this formula pre-supposes the existence of a normal crop below age x. If these are in deficit, after r—x years we shall have less growing stock over age x than at present, and hence the formula would then give too large a yield.

Actual examples of the calculation of the yield by this modified formula, for N. Kheri and Thano W. C., Dehra Dun, are given below.

Heyer's method.

Let us now consider the application of Heyer's formula to a forest *where V represents only the growing stock over diameter corresponding to age* x (and neglects the volume below this diameter).

Heyer's formula is of course—

$$Y = i \pm \frac{V \sim nV}{Z} \quad (i = \text{real M. A. I.} \quad Z = \text{equalisation period}).$$

Where V is given by enumerations and volume factors
nV is obtainable from a yield table
Z is whatever the W.P.O.or forest owner decide

$$i = \frac{V}{\text{correct mean age of enumerated crop}} = \frac{V}{A},$$

The whole point for careful consideration is what exactly is meant by correct mean age of enumerated crop. If the various diameter (or age) classes are represented in numbers of trees by a, b, c

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* Put in terms of hard cash; the recognition of this error has resulted in an immediate *increased nett revenue* of over Rs. 3,00,000 per annum in one working circle (of under 50,000 acres) of one division in the United Provinces !

and the true age of the various diameter classes by p, q, r years then one value of the mean age is given by the fraction

$$\frac{ap+bq+cr+\ldots\ldots}{a+b+c+\ldots\ldots}, \textit{ and this is wrong.}$$

For if we take p, q, r . . . . reckoned from the age o, we are introducing exactly the same error as applying Von Mantel's formula to partial growing stock; and as V and nV represent only the volume over a diameter corresponding to x years old, it is evident that we *must* take the ages of the different diameter classes as the *working age*, *i.e.*, p—x, q—x, r-x, etc., or the period during which they show increment. The true calculation for the mean age thus becomes

$$\frac{a(p-x)+b(q-x)+c(r-x)+\ldots\ldots}{a+b+c+\ldots\ldots}$$
$$=\frac{ap+bq+cr+\ldots\ldots\ldots}{a+b+c+\ldots\ldots\ldots}x$$

In other words, in applying Heyer's formula to a crop over x years old the mean age and real M. A. I. must be calculated as from the age x and not from the age o. With this modification so long as the distribution of age classes below age x is adequate Heyer's formula will give an accurate yield.

Hufnagel's formula.

This formula as given by Hufnagel is applicable to selection forests where the crop over $\frac{r}{2}$ years old is enumerated. It is a useful formula where the increment is known.

$$Y = \frac{V + \left(ix\frac{r}{4}\right)}{\frac{r}{2}} = \frac{V + \left(ixr - \frac{r}{2}\right)}{\frac{2}{r - \frac{r}{2}}}$$

Where i = C. A. I. V = growing stock

Over $\frac{r}{2}$ years old r = rotation.

To make this applicable where the crop over x years old it measured and enumerated,

$$Y = \frac{V + \left(ix\frac{r-x}{2}\right)}{r-x}$$

Hufnagel recognises two variations of his formula according to whether the C. A. I. or M. A. I. is used. If the M. A. I. is used it must be calculated from age x and *not* from age 0. With the C. A. I. the formula gives a yield about 10% to 15% higher than by using the M. A. I.; the former is, therefore, more conservative.

Karl's formula.

This is a simple method where the C. A. I. and normal growing stock can be ascertained. It differs only from Heyer's by using C. A. I. instead of M. A. I.

$$Y = \text{real C. A. I.} \pm \frac{V \sim nV}{Z}$$

Where Z = equalisation period.

Illustrations of the use of formulæ in calculating the yield from some U. P. Working Plans.

(1) W. C. I. of N. Kheri Division. Sal II Quality forest 47,472 acres.

For this quality, x = 35 years = age of crop at which 8″ timber is first obtained.

From enumerations and the sal yield table the following table is drawn up (figures include only trees of 8′ diameter and over and timber of 8″ diameter and over) :—

Diameter class.	Mean Diamr.	No. of trees per acre of forest.	Timber volume per tree c.ft.	Total timber volume per acre c.ft	True and corrected mean age of Diamr. class	True and corrected mean age of forest	M.A.I True and corrected per acre	Periodic C.A.I. per acre.
4″—8″	6	...	...	...	35	...	...	...
8″—12″	10	35·56	7·5	267	53·5 / 18·5	...	...	28·4
12″—16″	14	13·39	25	335	71 / 36	...	..	16·9
16″—20″	18	7·31	54	395	90 / 55	...	...	9·2
20″—24	22	5·90	89	525	118 / 83	...	...	...
...	...	62·16	...	1,522	...	67·53 / 32·53	24·0 / 46·8	54·5

For the normal forest of same quality, rotation = 90 years, mature diameter = 18″. Normal growing stock (over 8″ diameter) = 1,390 c. ft. per acre*.

Age of crop over 8″ diameter = 35 years old and over.

In this forest the real growing stock *exceeds* the normal growing stock by about 10%(density = 1·1).

(*a*) Von Mantel's original formula.

$$Y = \frac{2v}{r} = \frac{2 \times 1522}{90} = 33{\cdot}5 \text{ c. ft. per acre.}$$

(*b*) Howard's modification.

$$Y = \frac{v}{\frac{3}{8}r} = \frac{1522}{33{\cdot}75} = 45{\cdot}0 \text{ c. ft. per acre.}$$

(*c*) The modification given in this note.

$$Y = \frac{2v}{r-x} = \frac{2 \times 1522}{90-35} = 50{\cdot}5 \text{ c. ft. per acre.}$$

(*d*) Heyer's original formula.

$$Y = i + \frac{1522-1390}{z} \quad \text{where } i = 24{\cdot}0.\quad z = 90$$

$$\therefore\ Y = 24 + \frac{132}{90} = 25{\cdot}5 \text{ c. ft. per acre.}$$

(*e*) Heyer's formula as modified above.

$$Y = 46{\cdot}8 + \frac{1522-1390}{90} = 48{\cdot}3 \text{ c. ft. per acre.}$$

(*f*) Hufnagel's formula.

$$Y = \frac{V + (i \times \frac{r-x)}{2}}{r-x}$$

Where v = growing stock.
i = *current* annual increment.
r = rotation.
x = age above which crop is enumerated and measured.

$$Y = \frac{1522 + \frac{54{\cdot}5 \times 55}{2}}{55}$$

$$= \frac{1522 + 1499}{55} = 55 \text{ c. ft. per acre.}$$

*The normal growing stock is calculated direct from yield tables by the recognised formula (*vide* Schlich, Vol. III, 3rd edition, page 227).

$$Gr. = n\left(a + b + c + \frac{d}{a}\right) + \frac{d}{2}.$$

If this is calculated with the figure for M.A.I. we get—

$$Y = \frac{1522 + \frac{46{\cdot}8 \times 55}{2}}{55} = 51 \text{ c. ft. per acre.}$$

(*g*) Karl's formula.

$$Y = \text{real C.A.I.} + \frac{V \sim nV}{Z}$$

$$= 54{\cdot}5 + \frac{1522 - 1390}{90}$$

$$= 56{\cdot}0 \text{ c. ft. per acre.}$$

Of these eight figures of yield for the W. C. I. N. Kheri, it is evident from what has been said above that (*a*), (*b*), and (*d*) are wrong. The working plan has conservatively adopted (*e*), *i.e.*' Heyer's formula or 48·3 c. ft. per acre, or 2,290,000 c. ft. for the whole Working Circle.

The average yield from 5 modified formulæ = 52 c. ft. per acre.

Thano Working Circle, Dehra Dun—

4,650 acres, sal forest between II and III quality. For this quality x = age at which 8" diameter timber is first produced = 37 years.

For the normal forest of this quality rotation 90 years—

nV = 1,157 c. ft. per acre.

M.A.I.—43·67 c. ft.

From complete enumerations to 8" diameter, and from the sal yield tables the following tabular statement is drawn up:—

Diameter class.	Mean diameter.	No. of trees per acre of forest.	Timber volume per tree c. ft.	Timber volume per acre of forest.	True and corrected age of diameter class and forest.	M.A.I. true and corrected	C A.I
8"—12" ...	10	24·0	7	168	56/19	...	16·0
12"—16" ...	14	14·6	23	336	74/37	...	14·6
16"—20" ...	18	5·3	48	254	96/59	...	5·4
20"—24" ...	22	1·9	78	149	129/92	...	...
TOTAL ...	...	45·8	...	907	69·1/32·1	13·1/28·2	36·0

In this forest the real growing stock is below normal, *i.e.*, density = 0·78, while the real increment is considerably below normal.

(*a*) Von Mantel's original formula.

$$Y = \frac{2V}{r} = \frac{1814}{90} = 20{\cdot}2 \text{ c. ft. per acre.}$$

(*b*) Howard's modification.

$$Y = \frac{2V}{\frac{3}{4}r} = \frac{1814}{67{\cdot}5} = 26{\cdot}8 \text{ c. ft. per acre.}$$

(*c*) The modification given above.

$$Y = \frac{2V}{r-x} = \frac{1814}{90-37} = 34{\cdot}2.$$

(*d*) Heyer's original formula.

$$Y = \text{M.A.I.} \pm \frac{V \sim nV}{Z}$$

$$= 13{\cdot}1 - \frac{1157-907}{90}$$

$$= 13{\cdot}1 - 2{\cdot}8 = 10{\cdot}3 \text{ c. ft. per acre.}$$

(*e*) Heyer's modified formula.

$$Y = 28{\cdot}2 - 2{\cdot}8 = 25{\cdot}4 \text{ c. ft. per acre.}$$

(*f*) Hufnagel's formula.

$$Y = \frac{907 + (i \times \frac{53}{2})}{53} = \frac{907 + 954}{53} = 35{\cdot}1 \text{ c. ft. per acre.}$$

$$\text{or } Y = \frac{907 + (28{\cdot}2 + \frac{53}{2})}{53} = 31{\cdot}2 \text{ c. ft. per acre.}$$

(*g*) Karl's formula.

$$Y = \text{C.A.I.} + \frac{V \sim nV}{Z}$$

$$= 36{\cdot}0 - 2{\cdot}8$$

$$= 33{\cdot}2 \text{ c. ft. per acre.}$$

In this forest the W. P. has again conservatively adopted the yield by Heyer's modified formula of 25·4 c. ft. per acre.

or 118,000 c. ft. for the whole Working Circle.

The average yield from 5 modified formulæ is—

31·8 c. ft. per acre.

A PLANTATION OF REMARKABLE GROWTH.

THE following history of an *Albizzia moluccana* plantation may, on account of its exceedingly rapid rate of growth, prove of interest :—

The plantation was apparently made with the object of furnishing fuel to the Port Blair Settlement. The timber, however, yields a very inferior fuel, but on the other hand, though very light, promises well as a packing case wood. As far as it is possible to judge from the smallish specimens hitherto obtained the timber takes nails well, seasons without undue cracking, and for its weight, is strong. Gamble comments on the growth of the tree in Ceylon and Java, and remarks an instance of its exceedingly rapid rate of growth. He says nothing as to the quality or use of the tree for timber.

The following is a record of the plantation taken from the *Plantation Journal* :—

The tree is not indigenous in the islands, and the seed was purchased by Mr. J. L. Baker, Conservator of Forests.

	KIND.	Year.	Acres.			WEEDINGS.				THINNINGS.	
Albizzia moluccana 12 × 12.	*E. rostrata and E. tereticornis* alternate lines.	1915	35	Density.	Remarks.	First—July & August 1915.	Second—1st to 23rd November 1915.	Cleanings—June 1916; September 1916.	Path clearing—March 1920.	March 1920.	March to May 1922.
Cost of Creation.				Rs. as.							
Jungle-clearing & burning ...	...	...	..	243 0	...	Cost ... ... Rs. 67 as. 8 p. 0	" 48 7 0	" ... ... 65 10 0 " 29 6 0	" 39 6 6	" ... ... 48 12 0 Value of fuel obtained ... 131 4 0	Cost ... ... 292 6 0 Value of fuel obtained ... 918 12 0 140 cords
Stakes & stakings ...	...	...	...	53 0	...						
Albizzia seed	...	...	...	10 9	...						
Sowing ...	...	...	...	13 0	...						
Eucalyptus seed ...	...	...	...	13 0							
E. Nursery ..	...	...	...	69 0	...						
Planting ...	...	...		78 0	...						
Refilling blanks ...	...	...	...	21 0	...						
Total ...	...	...	..	500 9							

This plantation has been formed on a conical hill, some 256 ft. high situated in the north-east corner of the Brigade creek, Reserved Forest. The configuration of the ground consists of steep slopes which rise up from the mangrove swamp on the south-east to a height of 256 ft. On the west the slopes are moderately steep. The original forest in this area was semi-evergreen in which *padauk* occurred along the lower slopes, whereas the upper portion was pure overgreen or *guryan* forest.

1915. *February and March.*—Cutting jungle over this area commenced on the 26th February and was completed on the 23rd March.

April.—The area was burnt on the 4th April, about ¾ of the area, *viz.*, those portions just cut, burnt well. The portion cut recently on the western face did not burn thoroughly, as piles were made of the half-burnt branches, and these were fired again.

April.—On the 5th April one pound weight of seed of *Eucalyptus rostrata* was sown in seed beds in small nurseries. On the 7th April ½lb. of seed of *Eucalyptus tereticornis* was sown in seed beds in nurseries, a few seed of *E. rostrata* germinated on the 10th April, by the 14th April seeds of both species of Eucalyptus had germinated freely.

On the 18th April eucalyptus seeds were still germinating. Some of the seedlings have been defoliated by a species of grasshopper.

May.—The area was staked out for eucalyptus planting and *Albizzia moluccana* sowing, the stakes being placed 12′ × 12′.

May and June.—Completed staking, sowing of *Albizzia moluccana*. *Albizzia moluccana* was sown 12′ × 12′, four seeds at each stake.

June.—Transplanted a few eucalyptus into baskets for road side trees for the Settlement and transplanted the rest on to plantation. The plants were planted 24 × 24. The *Eucalyptus Tereticornis* and *Eucalyptus rostrata* were planted in alternate lines.

1915. *July and August.*—Area was weeded. A. *moluccana* vacancies filled in at a cost of Rs. 67-8-0.

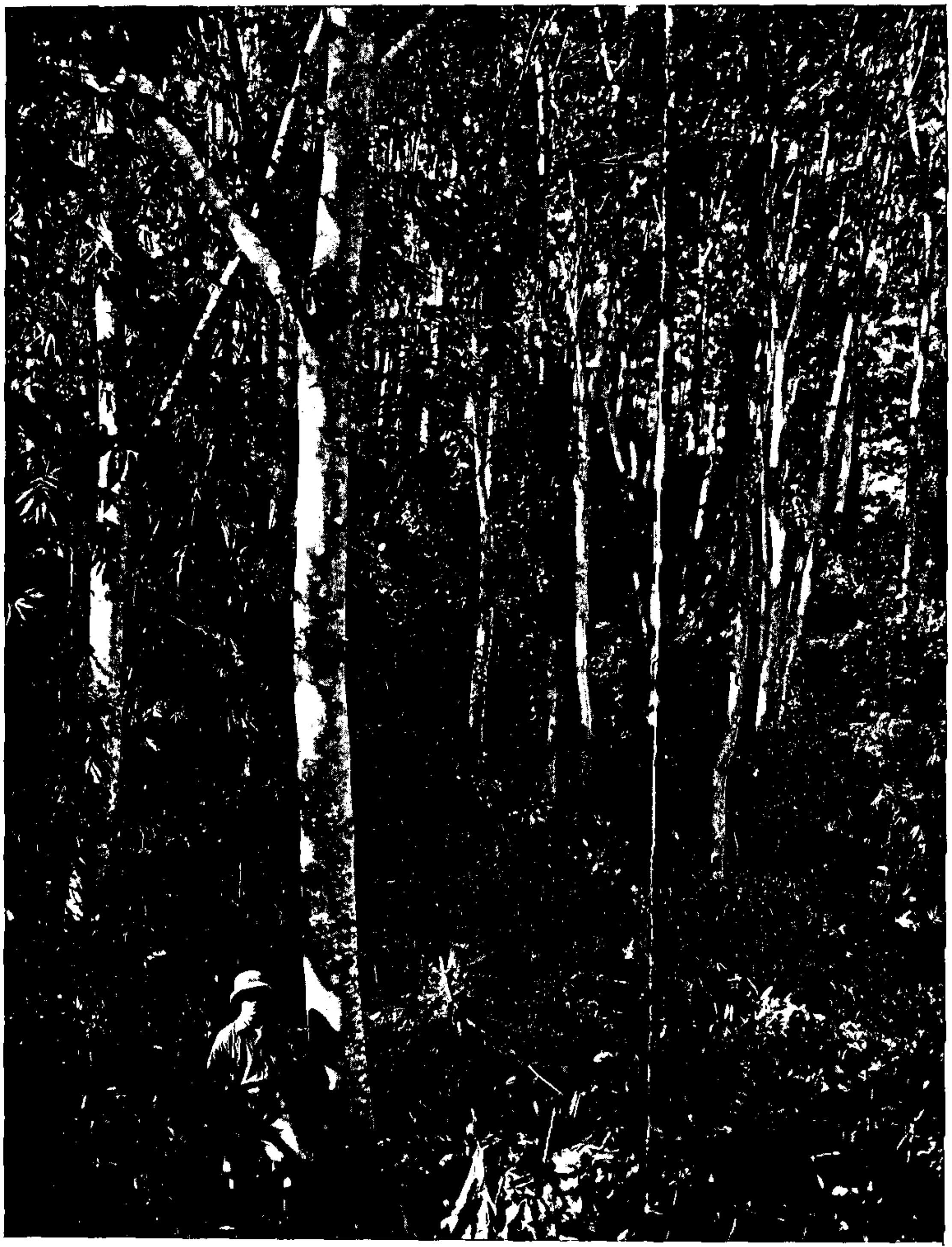


Photo by W. A. Robertson, I.F.S.

Plantation of *Albizzia moluccana*, Andaman Islands, from seed sown at stake, 1915.

November.—A second weeding was carried out at a cost of Rs. 48-7-0. The plantation is stocked with *Albizzia moluccana* and eucalyptus though these latter do not seem to be making much progress.

1916. *June.*—A thorough cleaning was carried out at a cost of Rs. 65-10-0. The *Albizzia moluccana* are growing remarkably well, some of the best trees measured 15′ to 17′ in height, whilst very few of the eucalyptus have done well. Though there are some good trees 12′ to 14′ high climbers are very numerous.

September.—A second cleaning was carried out at a cost of Rs. 29-6-0.

1920. *March.*—Paths were cleaned through this plantation at a cost of Rs. 39-6-6.

1920. *March.*—Eighty trees were thinned out at the foot of the hill towards the south-east of the plantation at a cost of Rs. 48-12-0. Twenty cords of firewood were obtained from them. The estimated value of this is Rs. 131-4-0.

1921. *December.*—A sample plot of one acre was measured. There were 177 trees. The average girth calculated from basal areas was 2 ft. 7 in. A sample tree of 2 ft. 6½ in. was felled and measured with result as follows:—

Top branch piece,	13 ft. × 1 ft. 5 in. = 1·6	c. ft.
2nd piece (downwards),	27 ft. × 1 ft. 11 in. = 6·2	"
Butt piece ...	25 ft. × 2 ft. 5 in. = 9·1	"

Volume of tree. 16·9 c. ft.
" per acre. = 2991·3 "
or = 3,000 approx.
or 60 tons per acre,
i.e., 10 tons per acre per annum.

Total height of tree, 86 ft.

Height to lowest branch, 53 ft.

Girth just below 1st branch, 1 ft. 5 in.

1922. *March to May.*—A moderate thinning was made at a cost of Rs. 292-6-0. The thinnings were removed as fuel and yielded 140 cords sold for Rs. 918-12-0.

About 60lbs. of seed was collected from this and another plantation of about the same size and of the same age. (In 1921 collection of seed was begun rather late, but about 12lbs. was obtained.)

The eucalyptus has entirely vanished from within the plantations but there remains a little, just bordering the plantation. This appears to be the overgrown eucalyptus nursery. The growth has been good, but only about half that of the *Albizzia*.

Ignoring the eucalyptus which has failed, the total money spent on the creation, weeding, and thinning, amounts to Rs. 932-2-6, and the revenue obtained from the thinnings which were sold as fuel amounts to Rs. 1,050. Thus the plantation has already paid for itself and there remains a full crop.

Thus should the tree yield a useful packing-case timber as it promises well to do, it should prove of enormous value. The possibility of using it for matches is also promising.

The canopy created by a plantation is very light, and it is intended to try, if some of the *Dipterocarps* that are troublesome to grow, may not be raised thereunder.

J. W. BRADLEY, I. F. S.

HEIGHT GROWTH OF SEEDLINGS.

MONTHLY height measurements of selected seedlings forms part of the routine work at the Experimental Silvicultural Garden, Dehra Dun. In order that the results obtained should be made public, as soon as possible, it is proposed to publish these in the *Iudian Forester* at the end of every year. The first series having just completed their first twelve months the following data is published for information. The species under measurement were as follows:—*Shorea robusta, Cedrela Toona, Acacia Catechu, Dalbergia Sissoo, Bombax malabaricum,* and *Terminalia tomentosa.*

The seed was sown in May and June last year, and the monthly measurements began on October 1st of the same year.

Ten plants of each species were selected for measuring, and each plant was marked and numbered in such a way that there would be no difficulty in measuring the same plants each month and recording the measurement against each indentical plant monthly. The plants were not selected as having abnormally strong growth, or anything of that kind, but were picked out as good normal plants and allowed to grow up with the other plants in the nursery beds. When measuring was done the plants were held straight, and the ground round the base smoothed off, the height recorded being that from the ground level to the growing point. Long side branches, etc., were neglected.

The following tabular statement gives the average (for the ten plants of each species) monthly height measurements in inches :—

SPECIES.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.
Shorea robusta ...	4·4	4·7	4·7	4·7	4·8	4·8	4·8	5·1	5·9	9·7	12·0	13·1
Cedrela Toona ...	4·5	5·8	5·9	5·9	6·3	7·3	8·3	10·6	17·6	25·4	31·3	33·9
Acacia Catechu ...	28·5	28·6	28·6	28·6	28·6	28·2	28·7	28·5	29·3	47·0	63·0	73·3
Dalbergia Sissoo ...	11·9	11·9	11·9	11·8	11·7	12·0	14·6	16·7	17·7	25·4	27·9	39·5
Bombax malabaricum	8·1	8·3	8·4	8·4	8·4	8·4	8·4	8·5	9·3	10·6	16·1	17·6
Terminalia tomentosa	11·5	12·1	12·2	12·1	12·3	12·3	12·1	12·2	14·3	22·2	36·3	47·9

The actual increase in growth during each month is as follows. In cases were there was a decrease it generally meant that one or more of the plants were killed back by frost or drought, thereby reducing the average :—

Species.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.
Shorea robusta ...	...	·3	...	...	·1	...	...	·3	·8	3·8	2·3	1·1
Cedrela Toona ...	...	1·3	·1	...	·4	1·0	1·0	2·2	7·0	7·8	5·9	2·6
Acacia Catechu ...	...	·1	...	...	...	...	·5	...	·8	17·7	16·0	10·3
Dalbergia Sissoo ...	...	...	...	...	...	·3	2·6	2·1	1·0	7·7	2·5	11·6
Bombax malabaricum	...	·2	·1	...	...	...	...	·1	·8	1·3	5·5	1·5
Terminalia tomentosa	...	·6	·1	...	·2	...	...	·1	2·1	7·9	14·1	11·6

Conclusion.

There is little to comment on. It will be seen that growth is practically at a standstill during the months when there is no rain, and, in order to bring out the direct relation between rainfall and growth in trees, the following diagram has been prepared. The similarity in the curve of *Acacia Catechu* and the rainfall curve is so great as to make one wonder whether in future years it will not be possible to read off heights direct from the rainfall curve, using of course, a reducing factor for each individual species ! ! !

The *Cedrela Toona* and *Dalbergia Sissoo* curves are interesting as showing that both these species grow steadily through the hot weather, whereas the other four species do not start their growth until the rains break. The winter rains seem to have no effect on these trees, except, perhaps, in the case of *Cedrela Toona* which grows steadily throughout practically the whole year.

One other point of interest is that all the above species are those with distinct annual rings, or, at any rate with annual rings which can be distinguished clearly under a microscope. It would be of considerable interest to study the growth of those trees in which no annual rings are distinguishable, and to see if the actual growth of these trees also is confined to the three monsoon months. It is hoped that some such experiment will be started forthwith. The results of such a comparison should prove both interesting and instructive.

H. TROTTER, I. F. S.

THE EFFECT OF FIRE, SHADE, AND INJURY ON THE GROWTH OF *PINUS LONGIFOLIA* SEEDLINGS.

PLATE I shows 3 seedlings dug up in July of the year following germination (*i.e.*, they are 12 months old). They grew at an elevation of about 3,500 ft. on the present quality soil, and, though they were on a western slope, the spur on which they grew was fully exposed to the southern sun.

Seedling Nos. 1 and 2 are from sowings in one and the same bed, dug to a depth of 8 inches, the soil being mixed with wood

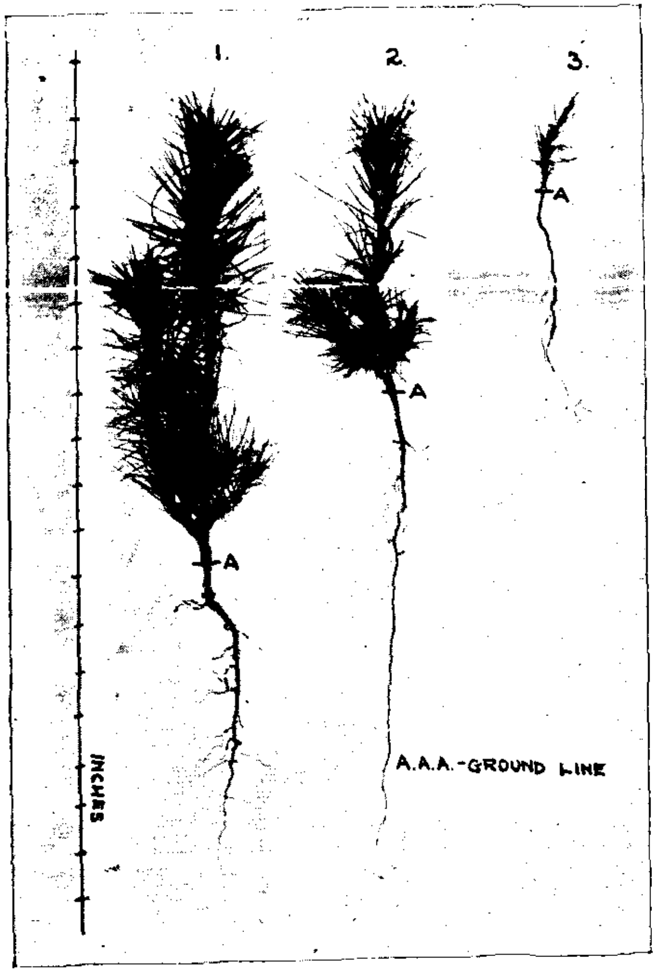


Fig. 1.

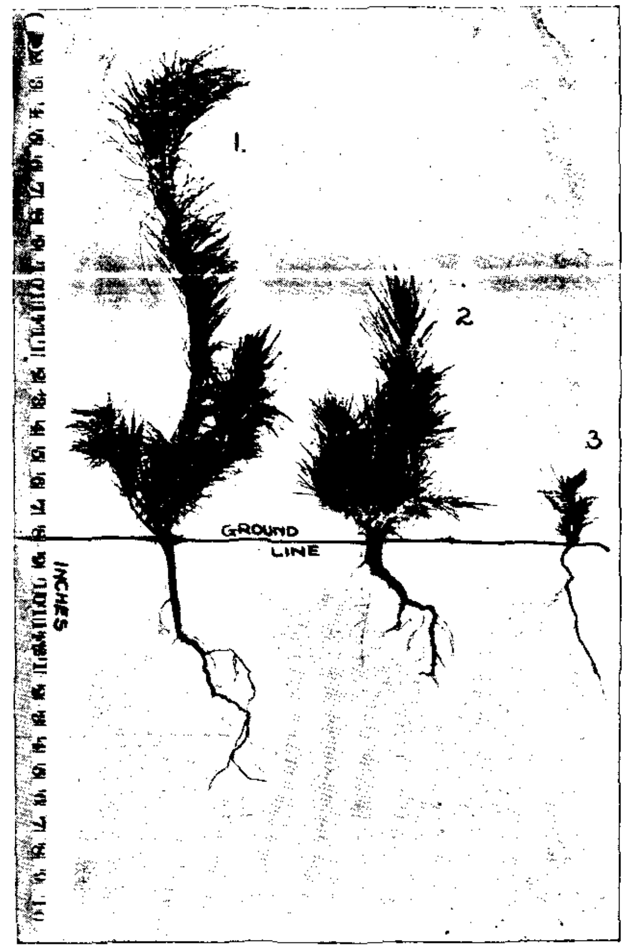


Fig. 2.

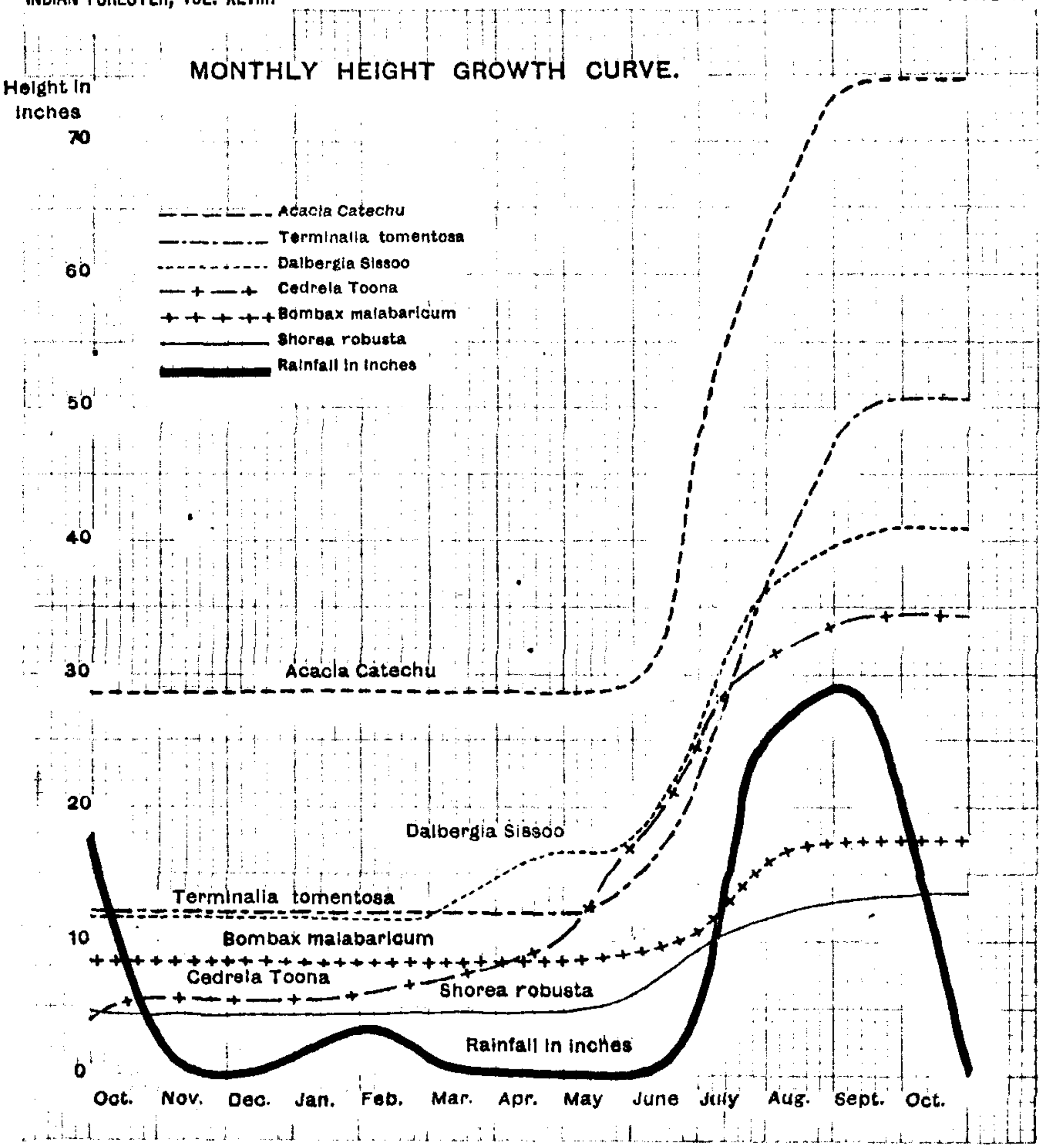
ash from burning felling *débris*. Seedling No. 1, 11 inches high, was fully shaded during the hot weather; seedling No. 2, 7 inches high, was only partially so shaded. No. 3, 3 inches high, is a natural seedling obtained from a few yards away from the bed on which the other grew from the north side of the spur, the soil on the spur itself being too impoverished to support any natural regeneration. These seedlings are fairly typical and illustrate the enormous benefit derived from preliminary burning and the shading of the plants in the hot weather.

Plate II, however, presents some much more interesting phenomena. In the month of June 1921 a fire swept through the Sangseri forest in Rawalpindi East Division. Owing to the long continued drought and the presence in the forest of an enormous quantity of felling *débris* and fuel stacks the fire was a terrific one. In July 1921 the Divisional Officer, Khan Fazl Muhammad Khan, had pine seed scattered in the heaps of ashes left from the burning of the fuel stacks. At the same time a considerable quantity of seed was scattered over the area from the mother trees. This plate illustrates two of the seedlings dug up in August 1922 from this forest and a natural seedling obtained from a similar locality in an unburnt area (*c.f.*p. 35, Troup's *Pinus longifolia*, Indian Forest Memoirs). Seedling No. 1, 20 inches high, was obtained from under a half-burnt felled tree and had thus obtained the full benefit of shade throughout the hot weather, its growth is somewhat above the average of the crop, and it is probably a natural seedling. Seedling No. 2, 11 inches high, is an artificial seedling obtained from one of the ash heaps; its height growth is rather below the average of the crop. My view is that the direct effect of wood ash is quite insufficient to account for these truly extraordinary growths. If wood ash were alone responsible, we should expect to find at least as good growth in a nursery and good soil where the soil had been dug to a great depth and mixed with a large quantity of wood ash. Yet in the Punjab Forest School nursery, which supplies these conditions, the plants, though of good growth are in altogether a different class to those growing in the severely burnt portions of Sangseri forest; the difference is certainly as much as 200 per cent. It

would appear then that the quality of the growth improves with the severity of the fire, and that it is dependent to a great extent, on the amount of heat generated. It has been pointed out in the *Indian Agricultural Journal* XVI, Part 3, quoted in the *Indian Forester* for September 1921 that, though both the bacteria favourable to and detrimental to plant growth are destroyed by heat, the former re-establish themselves more quickly than the latter. It seems possible, therefore, that in this case we have a severe fire acting like Wells "Food of the Gods" and eliminating the growth-retarding factors.

I have always assumed that the main advantage derived from a fire was the manurial value of the wood ash. If, however, the direct effect of heat is of the importance indicated above this will have a most important bearing on our regeneration operations. For example, it might point the way to combining efficient regeneration with clear felling on the American system, and thus remove one of the chief economic difficulties in modern forestry. Further, it would appear that burning may lose a great part of its value if it is not followed by immediate seeding.

There is a peculiarity in seedling No. 2, Plate II, which I am not altogether able to account for, and that is the thickened carrot-like root. This is very common in *Pinus longifolia* seedlings *after* fire (*c.f.*p. 44, Troup's *Pinus longifolia*, Indian Forest Memoirs), and I have always believed it to be caused by an injury (usually fire) giving rise to coppice shoots. In fact, when I originally received a sample of the extraordinary Sangseri seedlings through the post, viewing the colossal growth and very thick carrot root of the specimen, I unhesitatingly set it down as a coppice shoot from a two or three-year-old root. An inspection of the forest, however, proved this theory to be impossible, and showed also that these thickened roots were by no means universal or confined to the biggest seedlings. It is stated, however, that there was an insect attack after the seedlings germinated, and that many of them were cut off. Certainly there are now to be seen several plants with no leaders at all, but with a magnificent crop of coppice shoots, all of equal length, surrounding a


MONTHLY HEIGHT GROWTH CURVE.
Height in inches
70
60
50
40
30
20
10
0
Acacia Catechu
Terminalia tomentosa
Dalbergia Sissoo
Cedrela Toona
Bombax malabaricum
Shorea robusta
Rainfall in inches
Acacia Catechu
Dalbergia Sissoo
Terminalia tomentosa
Bombax malabaricum
Cedrela Toona
Shorea robusta
Rainfall in inches
Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct.

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hollow core where the leader presumably existed originally. It appears, therefore, that the carrot root may be due either to the stimulus of the fire which occurred *before* the fall of the seed or to an insect attack after the germination of the seedling. The absence of the leaders in some plants points to the latter cause but it is peculiar that an injury should have been allowed of the enormous and healthy growth, evidenced by some of these carrot-rooted plants.

M. R. K. JERRAM, I. F. S.

NEWLY-APPOINTED ASSISTANT CONSERVATORS.

The following 29 I. F. S. probationers, who have recently completed their course of training in Great Britain, have been appointed Assistant Conservators of Forests and posted to the Provinces shown against their names:—

Government of India Order of Merit List.

1.	M. D. Chaturvadi	(Oxford)	United Provinces.
	R. M. Gorrie	(Edinburgh)	Punjab.
3.	D. T. Griffiths	(Cambridge)	Burma.
4.	F. W. Withers	(Oxford)	Burma.
5.	C. K. Homfray	(Cambridge)	Bengal.
6.	P. W. Davis	(Cambridge)	Madras.
7.	E. C. Mobbs	(Cambridge)	U. P.
8.	R. S. Browne	(Edinburgh)	Madras.
9.	Jhunna Singh	(Oxford)	Punjab.
10.	J. S. Vorley	(Cambridge)	Burma.
11.	Abdul Vahid	(Oxford)	C. P.
12.	F. T. Morehead	(Edinburgh)	Burma.
13.	E. A. Garland	(Cambridge)	Bombay.
14.	J. A. Wilson	(Cambridge)	Madras.
15.	W. H. Samler	(Oxford)	Punjab.
16.	C. M. Chaudhri	(Oxford)	Bihar & Orissa.
17.	H. E. Flint	(Cambridge)	Burma.
18.	J. W. R. Sutherland	(Edinburgh)	Burma.
19.	E. S. Tavener	(Cambridge)	Bombay.

Government of India Order of Merit List.

20.	N. G. Pring	(Oxford)	Punjab.
21.	H. A. Hicks	(Oxford)	Madras.
22.	D. W. Hughes	(Cambridge)	Burma.
23.	H. L. Kirby	(Edinburgh)	Burma.
24.	W. D. M. Warren	(Edinburgh)	Bihar & Orissa.
25.	A. Hyde-Johnson	(Oxford)	Burma.
26.	H. S. Deans	(Edinburgh)	Punjab.
27.	A. F. R. Brown	(Cambridge)	Burma.
28.	J. E. M. Mitchell	(Edinburgh)	Madras.
29.	B. M. Colchester	(Oxford)	Bombay.

In addition the following two recruits appointed probationers in 1922, who already possess degrees in Forestry, will be sailing for India towards the end of December next (1922) in order to join for duty in the provinces shown against their names:—

F. C. Osmaston	(Oxford)	Bihar and Orissa.
C. L. Chadha	(Edinburgh)	Central Provinces.

I. F. S. PROBATIONERS APPOINTED IN OCTOBER, 1922.

(Completing Course of Training in October 1922.)

At University of Oxford —

		Appointed 1922.
K. L. Aggarwal ...	...	In India.
J. Coode ...	...	"
J. Costello ...	...	"
T. A. W. Davis ...	...	"
J. Gentle ...	...	In England.
R. M. Graham ...	...	In India.
R. C. Holcroft ...	...	"
B. Janakiran Singh	...	"
L. W. Jennings ...	...	"
V. S. Kuppuswamy	...	"
N. Pal	...	"
D. D. Saigal ...	...	"
N. N. Sen ...	...	"
J. R. Singha ...	...	"
Tara Singh ...	...	"
L. H. Wah ...	...	In England.

At University of Cambridge —

J. A. Clarke	...	...	In India.
M. N. Gallant	...	...	In England.
C. W. Kermode	...	...	,,
J. H. D. LaTouche		...	,,
F. J. Mustill	...	...	,,
L. E. Smith	...	...	In India.
C. H. Thompson	...	...	In England.
J. O. Wadhams	...	...	,,

THE NILAMBUR WORKING PLAN.

A BURMA REVIEW.

THIS Working Plan, which was heralded with a flourish of trumpets in the I. G. F.'s inspection note on his tour of inspection of forests in the Madras Presidency, dated January 1919, has at last appeared. The plan is of such great interest to the Burma Forest Officer that he may be excused of having complained of the delay in publication, and, although Mr. Bourne has ample excuse for this delay, we think that earlier publication of such portions of the plan as the yield tables, which did not depend on the supply of maps, might with advantage have been made. Even now we still await Mr. Bourne's note on the methods of preparing yield tables promised in the last paragraph of his introduction to Vol. I. It is to be hoped that this note will not be forgotten. It will certainly be most helpful to us in Burma.

The Working Plan, now it has been published, fully bears out our expectations, and we would congratulate Mr. Bourne on the result. He is fortunate, indeed, to have been in a position to draw up a working plan for fully-established forest containing a series of even aged teak woods which, thanks to the foresight and enthusiasm of Mr. Conolly and other pioneers, has been formed. In Burma in spite of our thousands of acres of teak plantations dating from the sixties of the last century on, owing to the mistaken policy of trying to grow teak where no teak existed previously, it cannot be for another 60 or 70 years the lot of the Burma Working Plans Officer to have a series of ready-made even-aged woods on which to base the working of his forest. We have few criticisms to offer, and these may well be left to the end. We would rather dwell on the points in the Working Plan from which lessons may be learnt by the Burma Forest Officer especially. On reading through the Working Plan we are struck by the number of problems which are almost identical with the problems that are engaging our attention in Burma, and we would recommend the method by which Mr. Bourne has tackled many of these problems to the careful attention of Burma Forest Officers.

We propose to deal serially with the more important of these points.

1. Para. 104.—*Reasons for adopting departmental agency in exploitation.*—It is evident that there is an agitation against departmental extraction. Mr. Bourne has stated his case in favour of it very clearly and has shown the very serious reduction in the net revenue that would be entailed by sale of the timber, either standing in the forest or on the river bank. We are not altogether convinced that the prices owing to competition would not increase after a year or two, if a system of open sale of coupés were adopted, but the loss to Government would be undoubted. The principal point is emphasised by the clear figures with which Mr. Bourne can state his case. In Burma there can be little doubt that we shall shortly be faced by an agitation against departmental working which still continues in certain important forests in Lower Burma. Our case for the retention of these forests, under departmental

agency, is even stronger than Mr. Bourne's, as, apart from the very high returns, it is essential to have a means of testing the prices received in other forests worked by purchasers who might otherwise form a ring to restrict the fair share to Government, as the owner of forests. Moreover, a share in the marketing of the teak timber prevents an artificial standard of selling prices of the timber which would otherwise be possible were the whole of the teak outturn in the hands of a few firms. At the same time we have not yet organised the accounts side of our departmental extraction to be able to back up our case by showing the great loss in revenue which would result from the giving up of departmental extraction.

Choice of Species—for the conversion working circle (para. 218). We would especially commend this paragraph to the attention of all Forest Officers, and would congratulate Mr. Bourne on the very able way in which he has dealt with this very thorny problem. Briefly his conclusions may be summarised :—

1. Ordinarily only indigenous species should be taken into account.

2. It is not worth while cultivating an indefinite number of species on a small scale. Work must be concentrated on a few selected species of economic importance, each of which must be grown in sufficient quantity for the successful establishment of an industry dependant on it.

3. The species to be planted must be that best suited to the locality, and in the case of several species having equal claims the most profitable species must be selected.

Yet we think Mr. Bourne's conclusions cannot altogether be adopted in Burma as a whole. For one thing, he has to discard such species as *Adina cordifolia* and *Gmelina arborea* because they will thrive only in localities well suited to teak. It would, however, be unwise to banish these timbers from our future markets. *Gmelina* is so rapid growing in youth, and so easy and inexpensive to establish, that financially it may even compare with teak, specially in Burma where the teak prices cannot compare with the prices in Malabar. Moreover, timber markets can never be satisfied

with one or two timbers, and it is impossible to ignore a timber such as *Adina cordifolia*, which has very special properties. At the same time while not agreeing in all points with Mr. Bourne as regards the wide application of the subject over a whole Province, we consider his method of dealing with the subject for a single Working Circle a pattern that might advantageously be adopted by Working Plans Officers in Burma.

The account of the silvicultural operations connected with the regeneration and tending of the crop are of exceptional interest.

Formation.—The chief aim of regeneration appears to us to be to ensure the early establishment of a complete stocking of vigorous seedlings. This is undoubtedly what is attained in Nilambur; but at what cost? In para. 145 Mr. Bourne gives the cost of formation at the present time at Rs. 40 for the first year and Rs. 12 thereafter. In para. 110 the rate of coolie wages is stated to be 5½ annas to 6 annas. Calculating on a coolie rate of 12 annas, which is now barely sufficient in many parts of Burma, the cost of formation on the lines adopted in Nilambur would be Rs. 104 per acre. Our actual cost is probably a good deal less than Rs. 20 per acre, and, although it is possible that the stocking and early growth of our plantations is not so regular, there would have to be a very great difference in the returns to cover an increased cost of over Rs. 80 per acre at compound interest.

Efficient though the method of formation adopted in Nilambur is, we consider that the final word has not yet been said. The rate of coolie hire is rapidly increasing all over India, and more economical methods must be evolved. It will probably be found that at the loss of only a year or two in growth, a less thorough and more economical method will give equally good results.

Apart from the question of formation there are three points of exceptional interest to Burma Forest Officers. These are :—

(1) Spacing.

(2) Thinning.

(3) The encouragement of an undergrowth as a protection to the soil.

Spacing.—Mr. Bourne says he has found by experience that plantations spaced 8′ × 8′ or 9′ × 9′ are much more liable to develop forked leading shoots than those with a closer espacement of 6′ × 6′. He believes that this is due to the fact that after the great effort at height growth for the first three years or so, the individual teak sapling then attempts to develop a crown. If it is allowed to do this without check, the vigorous growth of side branches tends to weaken the growth of the leading shoot which is overtaken by vigorous side shoots. We believe this theory to be correct, and have frequently noticed the number of forked stems present in an under-stocked plantation. At the same time this process of restricting the crown must not be carried too far as will be shown in dealing with the next subject—Thinnings.

In Burma there have recently been several attempts to break away from the time-honoured spacing of 6′ × 6′. A spacing of 6′ × 9′ has certainly proved fairly successful so far, but it remains to be seen if it will lead to forked shoots. In one Division the spacing of 9′ × 9′ has been employed extensively over very large areas. It has certainly resulted in a considerable reduction in cost and a more even growth of seedlings owing to the increased attention that can be given them. At the same time it has yet to be seen if the same defect as has been noticed by Mr. Bourne in widely-spaced plantations will appear. Should it do so the saving of expense on the wider espacement cannot be justified.

Thinnings.—The information that Mr. Bourne can give us on thinnings outweighs everything else that we can get from his working plan. It explodes the whole idea that teak, as with European species such as conifers, must be grown close during the period of its greatest height growth. No greater mistake could have been made with teak. In Burma we have thousands of acres of teak plantations which had never received a thinning until 12 to 15 years of age. The result is deplorable, and probably accounts more than anything else for the disappointing results in so many of our teak plantations. The truth of the matter is, that once such a rapid-growing tree as teak is restricted and

forced to adopt a rate of growth suitable for the conditions of a closed wood it takes many years to recover its natural vigorous habit. The main object of thinnings in teak plantations must be to allow teak to retain this vigorous habit, while at the same time restricting its growing space only sufficiently to encourage a good height growth. Early heavy and repeated thinnings are essential. This method must be adopted in Burma in future.

Undergrowth.—It is extremely interesting to find that Mr. Bourne lays great stress on the evergreen undergrowth in teak plantations. We entirely agree with him as to the necessity of this condition. Teak gives by itself an insufficient protection to the soil. The ideal undergrowth both from the point of view of soil protection, as well as from the point of view of obtaining clean boles and of avoiding the formation of epicormic branches, is undoubtedly bamboo. Unfortunately bamboos, at any rate in Burma, are usually light demanders and cannot be underplanted under the teak in all cases with success. Moreover, they are unsuitable owing to their rapid growth for sowing as accessory species at the time of formation of the plantation. Under-planting, in any case, is probably an expensive process which cannot be justified on economic grounds unless the undergrowth can be turned to financial account in the final year. The more promising method of securing undergrowth would appear to be a mixture at the time of formation of some slow growing shade-bearer. In Burma we have recently adopted the practice of broadcast sowing to what are known as subsidiary species. The main object of this sowing has been the early formation of a complete stocking and resultant economy in the cost of weeding. At the present our most successful subsidiary species have been light demanders, such as the *Adina cordifolia* and *Stephegyne diversifolia*. These species, however, can merely serve as a temporary mixture with the teak. It is probable that once the plantations have been established, they will disappear owing to suppression by the teak. The only possible species as yet sown as a subsidiary species which may eventually form the soil-protecting undergrowth is *pyinma, Lagerstrœmia Flos-Reginæ*. This seems to promise fairly well. It grows considerably slower than

the teak, but it is possible that it may not be able to stand the heavy shade of the teak plantation in early years.

Under-planting of teak with *pyinkado* after a heavy felling at a fairly advanced age is also being tried, but the success is extremely doubtful.

Fire Protection.—Mr. Bourne appears to take fire protection of regenerated crops as a matter of course. He does not even consider the question of the more economic method of protection afforded by early burning. At the same time it must be admitted that the retention of an ever-green undergrowth necessitates fire protection.

We will complete this review by drawing attention to one or two minor defects. In the first place, we consider that a plan of this importance might well be printed on better paper. In the second place, Volume III, Appendix B, is we consider unnecessarily complicated. Admitted that all the variations produced by the use of different formulæ may possibly be worthy of record, we do not think that they are in place in a small handbook which is obviously intended for ready reference.

These are very minor points, and do not detract in any way from the value of Mr. Bourne's work on which he is very much to be congratulated.

H. R. B.

COMMERCIAL HANDBOOK TO THE GOVERNMENT RESERVED FORESTS OF SAMBALPUR.

BY MR. J. W. NICHOLSON, I.F.S.

FOREST WORKING PLANS are seldom read by any but the actual officers concerned, and consequently the valuable information which they often contain does not reach the general public. The Bihar and Orissa Local Government has given a useful lead in publishing their handbook on the commercial possibilities of the Sambalpur District. Mr. Nicholson, the Working Plan Officer, has put, in a concise form, all the information which a commercial enquirer would be likely to require. We think that the handbook

will be very useful to local officers who have to answer very varied enquiries. The book contains a clear map showing road, rail, and river transport facilities. In a revised edition, or in similar works prepared by our Working Plan Officers, we suggest that the capacity of the ordinary country cart should be given and also the limit of burden which the local country boats are able to carry.

The field covered by this handbook is comprehensive. There are sections on communications, quantities and kinds of forest produce, markets, labour supply, cost of exploitation, prices, and commercial prospects. If there was a handbook on these lines for every important division in India it would undoubtedly stimulate development.

We note that in Sambalpur District the most hopeful line of development on a large scale is the bamboo paper pulp industry. Mr. Nicholson has written a special note on this subject, to which we have drawn attention in our columns.

MINOR PRODUCTS OF PHILLIPINE FORESTS.

EDITED BY W. H. BROWN.

ANY addition to the very meagre literature available on this little known subject is always welcome. The three volumes under review give a large body of information and are a credit to the Phillipine Bureau of Forestry.

The general lines on which the information is assembled is that by groups of economic uses, though in one case, that of the mangroves, a special forest type is taken. From an industrial point of view this is probably the wisest, although it leads to a considerable amount of cross reference when the general economic use of any particular species is under investigation. Valuable tables of outturn have been included where possible, and these should prove useful to investigators in other countries. On the other hand, the size of the volumes has been swollen by botanical descriptions at various places, which seem rather out of place

in a book which from its arrangement is clearly meant to be utilitarian.

In contrast to the moist tropical regions of India the Phillipines have no large areas of bamboo forest, and the small number of species mentioned is in striking contrast to the number recorded from Burma. In this section some interesting notes are given on the results of planting *Bambusa spinosa* (*B. arundinacea*), but judging from the number of clumps dealt with the area under experiment seems to be too small to give really reliable figures of yield. This section is illustrated with photographs of botanical specimens of the various species, but the illustrations cannot be considered successful. Had line drawings been given instead, such as figure in several of the other sections to very good effect, the illustrations would have been very much more useful botanically. One point of economic information has here been omitted, namely, the average length of the internodes, which is of importance in many industries using bamboos and rattans.

With a book whose wealth of illustrations must be the envy of less favoured lands, and furnishes so much useful, up-to-date information, it seems ungenerous to find fault; but from the point of view of a foreign reader this book has one serious failing, namely, the almost entire absence of synonyms. While readily admitting that in their nomenclature the authors are "*the* people, and wisdom shall die with them," we think it would have been a kindly concession to the weaker brethren in other lands to remember that everybody has not got the Index Kewensis at their elbow to look up the synonyms which they may expect to find in the F. B. I. or in Pierre or Gagnepain. To have printed a few of the commonest names would not have added to the bulk of the volumes and we fear that for lack of these, not nearly so much use will be made of this book as it deserves.

W. A. R.

SUGGESTIONS WITH RESPECT TO THE FUTURE TRADE IN MYROBALANS.

Collection and grading of myrobalans.

With reference to the collection of the nuts in India the Committee do not consider that it will be possible to alter the present arrangements, which are largely in the hands of a combination of Indian firms. The collection of the nuts is essentially an Indian industry, and it is believed that it would be difficult to establish a European organisation for the purpose on a paying basis. Improvements in the condition of the nuts might, however, be effected if better storage accommodation were provided up-country, particularly in some of the Native States, where the nuts after collection are often left exposed to the weather, and consequently suffer considerable deterioration.

The grading of the nuts could also be improved. This work is usually carelessly done, and the standards of the grades have been lowered from time to time by the combination of Indian firms. Complaints on these points have been made by buyers in the United Kingdom, but the grades offered meet with a ready sale, and an increase in the price of the No. (1) reduces the demand for this quality and stimulates that for the No. (2). In these circumstances there is, unfortunately, little inducement to improve the grading in India. It would, however, be a great advantage if the nuts were carefully sorted before shipment and all unsound specimens rejected.

The Committee have considered the question as to whether it is necessary to continue the separation of the different varieties of myrobalans into two grades, Nos. 1 and 2. It is stated that the Cawnpore tanneries do not buy graded myrobalans; but, on the other hand, British tanners attach great importance to the grading, and in many cases they purchase only particular grades. In view of this fact it would appear necessary to continue the present method of grading in India.

At present myrobalans are purchased by British tanners largely on appearance, which has been shown to be an unsatisfactory method of valuation, and it would be better if they were sold on

a unit-tannin basis, controlled by colour determinations. It must, however, not be overlooked that myrobalans are often bought by tanners, not solely for the tannin present, but also for their other properties.

Form in which myrobalans should be exported.—Up to the present British tanners have preferred to purchase myrobalans in the form of the entire nuts, but recently increased quantities of the crushed myrobolans (freed from the stones) have been imported. It is thought that if the preparation of the crushed myrobalans were improved the bulk of the demand would eventually be for the material in this form. The committee are of opinion that it would be advantageous if an arrangement could be made for the regular supply of crushed myrobalans, the crushing to be carried out at convenient centres in India under organised supervision. The question as to the grades of myrobalans which should be crushed separately would have to be arranged with the Indian suppliers. The increased usage of crushed myrobalans would be promoted if they could be sold on the basis of an analysis made in the United Kingdom.

It is understood that satisfactory machines are available for removing the stones from the nuts, and if this operation were carried out on a large scale in India, it might be possible to utilise the kernels of the stones as a source of oil. The kernels are stated to form about 6·5 per cent. of the weight of the stones, and to contain 36 to 37 per cent. of a non-drying oil. On this basis the yield of oil from the stones would be only 2·5 per cent. It is, therefore, a question for further investigation whether the kernels could be separated from the stones sufficiently cheaply to make the extraction of the oil remunerative. Special machinery for cracking the stones and separating the kernels would probably be required.

Future market for myrobalans in the British Empire.—Myrobalans have always been extensively used by British tanners, and before the war the United Kingdom took 40 to 50 per cent. of the total exports from India. During the war the consumption of myrobalans in the United Kingdom increased

considerably owing to the expansion of the tanning industry, and if this development can be maintained, it is probable that larger quantities of myrobalans will be utilised here than in the past. A larger market for myrobalans might also be found in Australia and South Africa for use in conjunction with wattle bark produced in these countries.

The use of myrobalans in the dyeing industry is of less importance than the demand by tanners. It seems probable that the quantity required for dyeing purposes in the United Kingdom will remain constant at the pre-war level.

FURTHER INVESTIGATIONS REQUIRED.

Terminalia Chebula, the source of the myrobalans of commerce, is stated to be a very variable tree, and in the Hooker's *Flora of British India* six varieties are enumerated, some of which Gamble suggests, might perhaps, be better regarded as species. No information appears to be on record as to whether the fruits of the different varieties vary greatly in the amount of tannin they contain, and therefore in value as tanning agents. The Committee were of opinion that this important point should be decided, as the facts, when ascertained, will have an important bearing on the future collection and grading of the nuts.

An enquiry on the subject was accordingly addressed to the President of the Forest Research Institute at Dehra Dun. It appears from his reply that no systematic study of myrobalans has yet been made in India, but it is agreed that it is very desirable that this should be done. The Forest Botanist proposes to commence the work as soon as possible. The samples of fruit from the different varieties will be sent to the Imperial Institute for examination and tanning trials.

It would also be desirable to carry out further investigation in order to determine finally the best time for the collection of the nuts, *i.e.*, the degree of maturity at which they contain the largest percentage of tannin.

The Committee further suggests that an enquiry might usefully be held in India to investigate the methods generally employed in collecting, drying, grading, and storing myrobalans

before the nuts come on to the market. It is probable that considerable improvements could be made in the methods now employed with beneficial results to the condition and quality of the nuts. The question of the extended production of crushed myrobalans in India might also be included within the scope of the enquiry.

WYNDHAM R. DUNSTAN (*Chairman*).
H. ADAMSON.
W. E. COOPER.
C. W. DAWSON.
H. PERCY DENSHAM.
STUART H. GODFREY.
CECIL W. N. GRAHAM.
W. L. INGLE.
CECIL J. LONGCROFT.
HAROLD BROWN (*Secretary*). SAMUEL MILLAR.
October 1919.

MYROBALANS.

TABLE I.—*Exports from India.*

—	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18[1].	1918-19[1].
Total Exports, quantity ...cwt.	1,658,895	1,233,661	1,397,755	1,236,394	1,164,261	1,392,663	1,081,209	815,550	823,890
Total Exports, value ... £	465,097	333,520	414,280	379,626	350,450	470,157	413,103	315,303	328,936
To British Empire—	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
United Kingdom ...	681,112	486,829	686,980	504,001	644,389	937,037	796,531	717,479	655,086
Australia	22,365	15,222	16,047	10,597	27,273	28,142	13,404	...	...
Other British Possessions	3,656	3,875	1,111	5,743	5,438	21,960	22,690	...	...
TOTAL ...	707,133	505,926	704,138	520,341	677,100	987,139	832,625	...	...
To Allied Countries—									
United States ...	298,383	224,053	191,656	187,288	189,338	267,417	133,668	40,310	49,993
Philippines	...	...	...	...	2,188	...	...	...	...
Belgium	211,433	147,757	142,422	136,028	93,098	...	...	...	...
France	38,707	32,697	51,803	40,814	37,393	72,358	28,516	...	...
Italy	20,100	14,459	25,048	15,436	7,713	30,302	23,245	...	...
Russia	32,324	19,980	10,188	20,731	3,945	3,934	12,094	...	...
Japan	847	6,983	2,736	5,437	9,185	23,676	45,331	...	...
TOTAL ...	601,803	445,929	424,753	405,734	342,860	396,687	242,854	...	...

To Enemy Countries—									
Germany	304,842	233,039	228,634	270,767	121,962	...	...	...	...
Austria-Hungary ...	43,112	46,842	39,647	37,302	20,964	...	...	...	...
Turkey, Asiatic ...	12	87	68	91	14	25	12	...	...
Total ...	347,966	279,968	268,349	308,160	142,940	25	12	...	...
To Neutral Countries—									
Spain	...	...	...	...	1,126	...	...	...	...
China	368	40	408	1,710	39	2,568	966	...	...
Other countries[2] ...	1,625	1,798	107	449	196	6,244[3]	4,752[4]	...	...
Total ...	1,993	1,838	515	2,159	1,361	8,812	5,718	...	...

1. *Full details not yet available.*
2. *Includes " Other Foreign Countries in the Indian Trade Returns."*
3. *5,550 cwt. to Sweden.*
4. *4,694 cwt. to Norway.*

NOTE.—The figures for 1910-11 to 1916-17 are taken from the Annual Statement of the Sea-borne Trade of British India, and those for 1917-18 and 1918-19 from the Monthly Accounts for March 1919.

MYROBALANS.

TABLE II.—*United Kingdom Trade.*

—		1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918[2].
Imports— TOTAL.									
Quantity ...	... cwt.	515,216	576,624	565,222	560,600	778,984	861,729	674,377	748,130
Value ...	... £	138,744	162,646	176,855	162,941	292,297	499,629	639,563	788,591
From India—									
Quantity ...	... cwt.	511,222	572,122	564,462	559,100	770,906	860,871	674,377	...
Value ...	... £	137,670	161,438	176,621	162,413	289,577	499,290	639,563	...
Re-exports— TOTAL.									
Quantity ...	... cwt.	7,986	14,698	22,003	14,270	24,511	35,479[1]	761	4,460
Value ...	... £	2,491	4,531	6,277	5,232	12,055	26,797	556	4,749

1. *18,527 cwt. to Netherlands as against* nil *in 1912 and 1913.*
2. *Full details not yet available.*

MINOR FOREST PRODUCE: POTENTIAL SOURCE OF WEALTH.

KIPLING in several of his writings on the country-folk of the southern counties of England dwells lovingly on the ancient lineage of many of the humble thrifty workers on the land and on the valuable, though little valued, part they played in the life of the land. While the tale of the newly developing industries in India fills the eye in almost every newspaper, a cursory glance may be spared to one of India's oldest, yet inconspicuous, trades. The trade in question is that which takes in the curious jumble of articles, which go to make up "minor forest produce." This trade has an ancient and distinguished descent. It is, indeed, the trade which first linked up the markets of India with those of Europe and, later, brought the Europeans round the Cape to exchange their wares on the spot against such minor forest products as myrobalans, sandal-wood, lign-aloes and, cutch.

Ancient Records.

The earliest mention of Western trade with India refers to these articles. The author of the Periplus in about A. D. 80 wrote of what is almost certainly the leaves of *Cinnamomum Tamala* from Assam. Later, in about A. D. 540, Aetius and Cosmas the Monk, wrote of sandal-wood, spikenard and lign-aloes, being exported from India. As we come down the centuries the references become more numerous till, in the narratives of the early Portuguese traders, such as Barbosa, we read of *lac* (the dye), myrobalans, cutch cajeput oil, wild cinnamon, tamarinds, brazil-wood, *Cassia fistula* fruits, zedoary, southernwood, and the perfumes mentioned by the older writers. In fact, these products ranked as important with these old traders as the textiles with which the Indian trade was popularly associated later on. Although this old-established trade has, like the "new poor" in other countries, to cede the pride of place to parvenu industries, it is far from being dead or even dying, as the customs returns clearly show. True, some of the old favourites have disappeared. Zedoary

and zerumpet have gone to join mithridate and mandragora in the dust of forgotten herbals and leech books, but they have hardy successors. If we no longer care to purge ourselves with *Cassia fistula* there is Indian podophyllum to fill the pill.

Annual Export Values.

But to return to the export figures, the latest statement of sea-borne trade shows the following as the average annual value of exports of various minor products on the last five years. There was exported of nux-vomica Rs. 11·69 lakhs, of cutch Rs. 12·55 lakhs, of myrobalans Rs. 74·52 lakhs, of brush fibres Rs. 24·24 lakhs, of gums and resins Rs. 14·03 lakhs, of *lac* Rs. 635·97 lakhs, of essential oils Rs. 5·30 lakhs, and of *mowra* seed Rs. 4·62 lakhs. These figures make quite a respectable appearance, but they naturally include some of the lean years of the war. The corresponding figures for the year 1921 are better. Reckoning in lakhs they are :—Nux-vomica 26·59, cutch 13·09, myrobalans 61·17, brush fibres 16·31, gums and resins 15·17, *lac* 758·25, *mowra* seed 8·43, and when compared with the exports of timber of all sorts from India it turns out that these inconspicuous products easily exceed them, since for the corresponding periods the timber exports are 118·37 and 126·65 lakhs of rupees.

Significance of Imports.

Looking at it from another point of view the position is not as rosy as the above figures lead one to believe. While India has been exporting the above products she has also been importing produce of almost exactly the same nature to an amount which cuts heavily into the income derived from these exports. Thus in 1921 she imported brush fibres to the value of 0·3 lakhs, canes worth 6·66 lakhs, cutch 9·91 lakhs, gums and resins 27·51 lakhs, and so on. It is true that in a number of cases the imported products cannot be exactly replaced by Indian substitutes; but in others there is no doubt whatever that such substitutes could be found. Why then does India have to go abroad for products which she ought to be able to get within her own boundaries ?

Chiefly on account of ignorance of her own resources, but also through the apathy of her own traders. The ignorance is fairly easily explained. These minor forest products come from regions remote from the main ports and centres of trade and on their way pass through so many hands that their origin can often be traced only with difficulty even by those whose business it is to do so. Also the trade is ancient and well-established so that there is little incentive to study its inner workings. The apathy, on the other hand, has nothing to excuse or justify it, but it is so widespread and well recognised that no one, least of all the body of Indian traders, finds any cause of wonder in it.

Work of the Forest Department.

As guardians of the main sources of supply the forest department of the government has for many years realised that the country was not making the most of its resources in this direction; and since the start of the Forest Research Institute at Dehra Dun it has been trying to grapple with the many problems which the study of minor products involves. Until recently this subject occupied the position of a poor relation, and naturally so, in respect to the chief subject of research, namely, timber ; but during the last year, the poor relation has been given a seat of its own by the formation of a separate section in the branch of forest economy. Even in the days when minor produce was looked on as a side show the value of systematic investigation was proved by results. The present turpentine and rosin industries of the United Provinces and the Punjab are, to a great extent, the result of work carried out at Dehra Dun. An examination into the processes of distilling palmarosa oil has showed that it is possible to increase the yield of the oil by 20 to 50 per cent. through the use of scientifically-designed plant. Even though the work already done at the Institute ranges over an extraordinarily large number of commodities there still remains a vast amount to do. In addition to the obvious field of examining new or little known products, there is the much harder job of persuading a suspicious public to take them up and of putting

the trader in the way of getting supplies. There lies the main obstacle to progress, for if the trader stands accused of ignorance the Forest Department, as a whole, must also plead guilty to a lesser degree.

Markets for New Products.

It is in overcoming this obstacle, that the time slips by; so that to bring an investigation to a conclusion, whether successful or not, mostly takes several years; hence it is that the most striking successes have been obtained with products which were already known to some extent; but the time has now come when new sources have to be tapped and new products brought on to the market. Men, money, and patience are wanted. This last mostly becomes a habit with a forest officer, and therefore may be taken for granted; but the other two are more difficult to get. Research is too often supposed only to require one man and a microscope, whereas he is but *one link in a chain*. Sooner or later the research officer has to track the product to the parent plant in its natural home, but when information has to be supplied on products spread between Quetta and Kengtung, and from Hazara to Tinnevelly, single-handed investigation of them all is an impossibility, and many products must be left untouched.

Policy of Research Institute.

The investigator, moreover, is not free to take up just what product pleases him; he must be at the disposal of the trading public, and rightly so. But to be so he must sacrifice some of his touring time. The person who wants to know about camphor or cushion stuffings or the discoverer of an elixir of life, who would like it to be tested on the *corpus vile* of the research officer, must not be kept waiting indefinitely for an answer, so there is no alternative between curtailing the work in the field and finding more men to do the work. This latter means money; in other words, it cannot be done at present. The policy which the Forest Research Institute proposes to adopt to meet the present circumstances is to proceed with those investigations which have already been in progress for some time and to concentrate upon them in

the matter of field work, for example, Boswellia and Karaya gum and charcoal briquetting. Other investigations will be carried only on to the end of the stage of laboratory work in order to accumulate the preliminary information needed against the time when it may be possible to take up the field work on a larger scale. As an example one may quote the chemical examination of various essential-oil yielding plants and of the lesser known resins. Such preliminary investigation entails much team work among the various branches of the Institute. In each case the section of minor forest products has to call in the forest botanist for a strict identification of the material and the forest chemist for the often intricate analysis of the desired product. Much of this may at first sight seem to be mere superfluous labour, but the records of past failures and the disappointments has clearly proved to those who have experienced them that this rather slow and very inconspicuous work is the only real road to success.

Supply and Demand.

In addition there is the never-ending business of keeping a look out for useful information from other parts of the world —work which unfortunately cannot be carried out, as some might suppose, by a clerk armed with a pair of scissors and a gum-bottle. Finally there is the work of trying to bring supplier and consumer into touch. Of all the work of the section this is probably the most urgent, and yet the most disappointing. It is here that the lack of the personal touch is most felt. As mentioned before, many of the dealers in the lesser known products are small people often without a knowledge of English and with a very hazy idea of what is wanted of them or what they can really do. One will profess flamboyantly to supply every product in heaven and earth when in the end it is found that he is barely in a position to supply one. Another seems to imagine that any old product is as good as another and acts accordingly whether of malice or ignorance one cannot tell, and so on.

A Veritable Gold Mine.

On the other side of the picture is the dealer for whom a supplier or consumer has been found, but who omits to report

whether the information given has been of any use or not. Such, alas! are only too common. Still the work goes on, and since the number of enquiries increases and old enquirers come back for fresh information it is safe to suppose that the work of the section of minor forest products is useful to the community, though not as much so as the section would desire or could justify on financial grounds. The value of India's forest estate is gradually being realised by the educated public of the country, though, perhaps, mostly on account of the revenue it brings to the Government. What is also needed is a fuller appreciation of this property in respect to the potential sources of wealth to the country which it contains in its products. India's forests have recently been called a gold mine to the country, and the simile would be correct if the mine is held to be inexhaustible; but it must be remembered that to get the fullest yield systematic scientific development is essential as soon as the mine has passed the stage of "fossicking." That stage has been passed in our forests, and this article is designed to try and show what is being done to develop new gold-bearing veins and increase the winnings from old ones. In respect of minor produce India's forest state is in the position of a mine in need of fresh capital to develop the known lodes and to explore and prove new ones which are met with in the course of exploitation. Who knows but what these new lodes may not prove richer than the old ones?—[*Commerce.*]

RAILWAY SLEEPERS FOR INDIA.

At a time when, at the forthcoming British Empire Exhibition in London the products of India, her vast timber resources, her arts and crafts, are to be displayed, evidently to the material and economic advantage of this country, it is really disheartening to know that the Indian Railways have placed orders for a large quantity of Railway sleepers in Canada. It is estimated, says *Commercial India*, a magazine published in Calcutta, that more than 4,000,000 new sleepers per annum will be laid by the Indian Railways during the next few years in the Canadian market. Ever

since the Burma Railways were laid out in this province, they have used what is known in Burma forests a variety called *pyingado* or iron wood for sleepers. The value of *pyingado* was realized only during the War, although before the War, once or twice, the Bombay Burma Trading Corporation and another firm had exported sleepers for the use of Indian Railways, and it is reckoned that during the years, 1920-21, 1921-22, more than 25 lakhs of sleepers have been requisitioned from Burma for Indian Railways. The hand-book of forest products of Burma published by Mr. A. Rodger, once Officiating Conservator of Forests published under the authority of the Government of Burma, speaking of *pyingado* as one of the most useful and plentiful woods of Burma, says: "It is in great demand for bridges, railway sleepers, and buildings, is never attacked after felling by insects, and can be obtained in large quantities. Many ordnance stores were made in Burma during the War of this wood." Now we fail to understand what necessity there is for the Railway Board to place a very large order for sleepers in Canada. Canadian sleepers were unknown in this country until 1921, when for the first time more than £200,000 worth of sleepers were imported from the Dominion. In fact, the Canadian sleepers are inferior in quality, in strength and in durability, as compared with *pyingado* sleepers. The Canadian sleepers are, we believe, made of American pine wood known as Zara wood which is much softer and inferior. For the sake of preservation from insects, it is said that Canadian sleepers are soaked in oil. Even in the matter of price, while a *pyingado* sleeper costs Rs. 9 c. i. f. Calcutta, the Canadian sleeper perhaps costs Rs. 14 each. Now let us ask what necessity was there for importing Canadian sleepers, when *pyingado* wood which is a stronger material costs less, and why should the Railways incur an additional expenditure? The way in which these orders have been placed in the Dominion shows that the object of the British Empire Exhibition will be frustrated. Instead of finding a Canadian market for Indian timbers by imparting to the Dominion a knowledge of the good qualities of these timbers, it is a suicidal policy to allow Canada to encroach upon the Indian Market. Last year, a new Timber Testing Laboratory was opened at

the Forest Research Institute at Dehra Dun, which is equipped with Standard machine and which is placed under the direction of a former Chief of the Division of Timber Testing of the Forest Products Laboratories of Canada, and Indian timbers were tested with certain Canadian timbers imported to India, notably Douglas Fir, and the quality of the former was found to be decidedly high. We do not know whether the Canadian Zara wood which is used for sleepers was tested or not. At any rate, it will be bringing coals to Newcastle to import Canadian sleepers into India. It had been demonstrated that the Indian forests which cover an area of 240,000 square miles, that is, about a quarter of the entire length and breadth of the country, to which must be added 12,468 additional square miles under the supervision and control of the Indian Forest Department are capable of being properly developed so as to supply not only Indian requirements but also to export very large quantities to other parts of the British Empire. It is calculated that the Forest Department has already catalogued 2,500 distinct varieties of timber and another 2,500 varieties awaiting classification. In spite of these vast resources, the imports of timber in 1918-19 were 35,730 tons, in 1919-20, 68,036 and in 1920-21, 62,382 tons, while the exports during these three years were only 138,383 tons. Who is responsible for the lack of enterprise and development with regard to the vast timber resources of India ? If the timber market is to be invaded by Canada, there will absolutely be a great deal of disappointment on the part of Indian traders. If the Railway Board is responsible for placing a very large order for Railway sleepers on the Canadian market, the sooner it is called to order the better. Is it not necessary that some member of the Legislative Assembly should interpellate the Government as regards the truth of this order and as to who is responsible for it? It is said that Sir William Meyer, the High Commissioner for India, gave a reception the other day to view the Indian timber panelling and furnishing that he has made in his offices in London. Such a show will be regarded as a sham when Indian timbers are not made use of, in the country of their birth.—[*The Rangoon Daily News.*]